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THE CRAB PARASITE, SACCULINA.

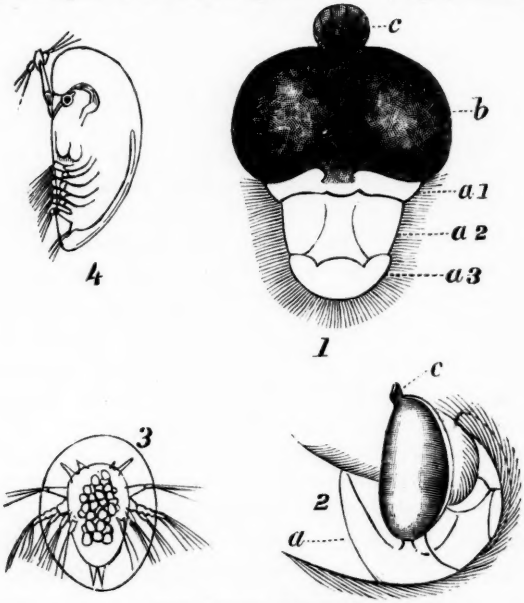
BY CARL F. GISSLER.

SOME three years ago I received a small number of crabs, preserved in alcohol, that had been collected by Dr. Van Elsen in the neighborhood of Tampa, Hillsboro county, Fla. The scientific name of the crab is *Panopæus herbstii*, described by A. Milne-Edwards, a crustacean which has been introduced from farther south, Key West, the West Indies and Brazil, where it occurs most abundantly. Once in a great while an occasional straggler from those southern waters is found on the shores of New Jersey, Long Island and Connecticut. Three other species of the genus Panopæus permanently occur from Florida up to the New England States, *Panopæus harrisii*, *P. depressus* and *P. sayi*. Our *P. herbstii* is easily distinguished from the other three species, as taught by Professor S. I. Smith, of Yale College, "by a tubercle on the sub-hepatic region, just below the first lobe of the antero-lateral border of the carapax, also by the post-orbital tooth being separated from the second tooth of the antero-lateral margin by a rounded sinus, and by the dactylus of the larger cheliped having a stout tooth near the base within." It is well known that all these Panopæus species largely contribute to the food of many marine fishes.

So much for the Panopæus. But our *P. herbstii* does not so much interest us at present as does its enemy, which is also a crustacean, living parasitically on its host. It does, however, not parasitize in the gill-cavity of its host, as is the case with the parasite Bopyrus infecting the common shrimp of our shores,[1]

[1] *Scientific American*, Vol. XLV, September 3d, 1881, p. 151.

but occurs on the ventral surface of the abdomen of its host. The scientific genus-name of our parasite is Sacculina, and by calling it specifically *Sacculina panopæi*, we honor both parasite and host. In systematic zoölogy this Sacculina belongs to the family Rhizocephala, and these again are classified among the barnacles or cirripeds, which the earlier zoölogists regarded as mollusks, but which, in reality, are crustaceans and relatives of the lobster, shrimp and crab. Sacculina is one of the most striking examples of animal degeneration. Fig. 3 illustrates the



EXPLANATION OF FIGURES.

FIG. 1.—*Sacculina panopæi*, female enlarged (male unknown). Ventral view. Color brownish.

c, abdominal, sub-segmented portion.

b. thoracic portion, the sac filled with eggs.

a^1, a^2, a^3. } the last three segments of ventral surface of abdomen of *Panopæus herbstii*.

FIG. 2.—*Sacculina panopæi*, female, enlarged. Lateral view.

a, abdomen of *Panopæus herbstii*.

c, abdominal portion with sexual orifice.

FIG. 3.—Nauplius stage of *Sacculina purpurea*. (After Fritz Müller.)

FIG. 4.—Pupa stage of *Lepas australis*. (After Darwin.[1])

[1] Chas. Darwin. A monograph of the sub-class Cirripedia, 2 Vols., London, 1851–54.

youngest or so-called *Nauplius* stage of another Sacculina, *S. purpurea.* It is a free-swimming, active larva, has neither eyes nor mouth; its "*cypris*" and pupa stage,[1] differs from the same of the near allied barnacles by the absence of the paired eye on the ventral surface of the head, Fig. 4.

In another later paper[2] I have described and figured the "embryo" of the Bopyrus infecting the common prawn, calling that "embryo" the highest and most advanced stage in the development of Bopyrus, which, under favorable circumstances, will enter the gill-cavity of the earlier developmental stages of the prawn, where it, as the prawn advances in growth, will, when a female, lose its eyes, both antennæ, the uropods, etc.; while the pleopods will degenerate into the abdominal lobes and from the seventh free segment will bud a pair of legs. What a clumsy and helpless creature the adult female Bopyrus is, may be learned from the description and illustration given by me in the two journals cited. But our Sacculina is much more degenerate, it is the most utterly reduced parasite known. Its body is a mere sac (measures $2\frac{2}{6}^{mm}$ in thickness, 6^{mm} in width and $4\frac{3}{6}^{mm}$ in length, figs. 1 and 2), of kidney shape, convex anteriorly, posteriorly concave in the middle and filled with a great number of minute eggs. Its lower constricted portion is securely attached by a short stem, like a barnacle, to the third last segment on the ventral surface of the abdomen of (in this case a female) *Panopæus herbstii*, which abdomen, upon dissection, exhibits a large number of branched tubes, originating from the stem of the parasite and distributing over and entangling the intestinal tract of the crab, thus endosmotically absorbing nourishment from the same. Some of these tubes terminate blind, others form delicate plexuses. At the upper constricted portion of the bag we notice a small, roundish, fleshy piece, flattened antero-posteriorly. It has some resemblance to the fog-pipe of a steamer. Its posterior surface is convex and sub-segmented into seven parts. It measures $1\frac{2}{6}^{mm}$ in width and $1\frac{1}{6}^{mm}$ in length. Its anterior surface is concave and provided at its lower half with a minute opening, the sexual orifice. The convex surface of the sac I presume to be the dorsal side, and the opposite, the concave, I take for the ventral side of the animal. The upper smaller part, resembling a fog-pipe, is the

[1] *Idem.*

[2] AMER. NATURALIST, Vol. XVI, January, 1882, pp. 5–12.

abdominal portion, and its segments are the remainder of the swimming legs of the pupa stage. The main body, the sac, is the thoracic portion of the former pupa. The cause for so reasoning is the supposed existence, in Sacculina, of what is known under the name of "dorsal organ" in the young of a great many crustaceans, even if such a structure has not yet been discovered among Rhizocephala. The peculiar attitude of the pupa stage in barnacles in the act of permanently attaching themselves to some marine object, tends to an assumption of analogy. I have repeatedly seen the "dorsal organ" and noticed its use in the young of branchipod crustaceans (Eubranchipus, Streptocephalus, Apus, Chirocephalus, Limnetis, etc.) in attaching themselves to the walls of the breeding jars in which they were kept. This organ appears to be of a glandular nature, is situated in most cases in the occipital region, is strikingly large in the young of some crustaceans, and gradually degenerates in the further development, but persists in some forms. The pupa of Sacculina may attach itself head foremost by means of the "frontal or dorsal organ" to the abdomen of Panopæus, the mouth and antennæ subsequently degenerate, the intestinal tract develops into a number of cœcal appendages, the latter enter the host, and the swimming feet, or cirri, are lost. The thoracic portion, or sac, is composed of an outer very tough skin and an inner more delicate membrane. This sac presents an analogy to the "marsupium" or breeding cavity of Bopyrus, for in it the eggs are hatched and protected until better fit to leave the mother animal. A constant current of sea-water between these two skins may probably exist for the aëration of the young; the entrance and exit for the water must, if there is no other opening, be through the sexual orifice. May not the extraordinary mode of obtaining nourishment render both parasite and host, physiologically considered, so to speak, but one animal? May not thus a condition be effected largely contributing to an oxygenation of the circulating fluid of Sacculina, a mere combination, as it were, of that of Panopæus? The "division of labor" in circulation, respiration and nourishment may be going on, in spite of the apparent absurdity in certain more or less differentiated individuals of those appendages or tubes. The question, What is degeneration due to as exhibited in Sacculina? we answer it is due to two causes: first, being a near relative of the barnacles, it is due to the metamor-

phosis of the Nauplius into a pupa and subsequently into an animal of a sessile and immobile habit of life; second, it is due to parasitism (Symbiosis). An approximate stability of the present form of Sacculina is maintained by the important law of heredity, very slow changes in color, form, etc., will, however, make their appearance by changes of climate and immediate surroundings, *i. e.*, the host. In concluding, let me quote from E. Haeckel: "The series of forms which the individual organism passes from the egg up to the development of the adult form is but a brief and rapid recapitulation of the series of forms, which all the ancestors of this organism have passed since the beginning of the organic history of the earth down to the present day. This repetition or recapitulation is conditioned through the laws of heredity and modified through the laws of adaptation. The historical record, preserved in the developmental history of the individual, is rendered gradually obliterate, the development gradually taking a more and more direct course from the egg up to the adult, and it is also often falsified through the struggle for existence which the free-living young are subject to. The falsification of the ontogenetic product is conditioned through the law of the modified or falsified heredity."

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MEN IGNORANT OF FIRE.

BY TITIAN R. PEALE.

IN theory, mankind differs from all other animals in the habit of cooking his food by the means of *fire*, which, in the progress of civilization, has improved so much as to become a science. Hence there are many grades of progress to be observed between the savage and the civilized man; and hence there are many facts worthy of record by the intelligent traveler, relative to the use of fire. I do not know of any but a single record where natives of a *newly* discovered country did not know the *use of fire;* that one case was on Island *Fanua Loa*, or Bowditch's island, discovered on the 29th of January, 1841, by the U. S. S. *Peacock*, commanded by Capt. W. H. Hudson, of the U. S. South Sea Surveying and Exploring Expedition (see Narrative by Ch. Wilkes, Vol. v, p. 10).

Captain Hudson relates: "The natives were at first very shy of the boats; but the Hawaiians who were in them soon induced them to approach, and to enter into trade, and finally enticed

them alongside the ships. On coming near they began a song or chant, holding up their paddles and mats, and shouting, 'kafilou tamatau.' They resembled the natives of Oatafu, or Duke of York's island, wore the same kind of mats, eye-shades and ornaments, and some were tatooed in the same manner. Some, however, were tatooed in a different style, being ornamented with a variety of arrows on the forehead and cheeks. They were all finely formed and manly in appearance, with pleasing countenances that expressed good nature.

"They were eager enough for trade, and soon disposed of all they had to exchange; a few presents were made them, but all inducements failed to entice them on board. They appeared cheerful, laughing heartily at anything that struck them as ridiculous. * * * * * * * * * *

"The population of this island is estimated to be about six hundred souls, most of whom dwell in the town.

"There were no signs of places for cooking, nor any appearance of fire, and it is believed that all their provisions are eaten raw. What strengthened this opinion was the alarm the natives felt when they saw the sparks emanating from the flint and steel, and the emission of smoke from the mouths of those who were smoking cigars."

The writer of this article was on board the *Peacock*, and can vouch for the verity of Captain Hudson's account of our interviews with the natives, and also that they eat their entire food without cooking, but also had the greatest dread of fire in any form. We saw no traces of charcoal or ashes in their village or town, and we fully understood them as to their food, and how it was taken. It consisted entirely of cocoanuts and pandanus fruits; fish, echini, and other products of the sea; the few sea birds mostly seen there, were not regarded as food, and even if they were, could not have been easily obtained or relied on for supplies, the population being large in proportion to the island's size.

In many of the semi-civilized islands of the Pacific ocean uncooked fish are still eaten as a delicacy; also echini, or sea eggs, as we eat oysters, raw, or "in the shell."

The terror of fire, as we witnessed it on more than one occasion at Bowditch's island, convinced us fully that down to the period of our visit the natives had never cooked their food; fuel was not abundant on any of the coral islands or attols, and fish were plenty and relished when not cooked. We saw a kind of half cooking at the Paumotu archipelago of fish, to preserve them for transportation to the Island of Tahiti.

The natives of Fanua Loa, when discovered, were quite ingenious in the construction of houses, canoes, and various fishing implements, mats, &c., considering the total absence of all metals, their island being of coral formation, and their having no communication with any other.

The various boxes, bowls, stools, &c., carved from the solid wood with sharks' teeth, and smoothed with coral and shark-skin files, were obtained and brought home, and formed a part of the nucleus of the National Museum in the Smithsonian Institution at Washington, where they now hold a place in the Ethnological Department; but, strange as it may appear, some wag, more learned than wise, wrote on a box containing fishing implements the words, "Tinder box," to contradict the statement by Captain Hudson, in Wilkes' published journal—a practical joke, no doubt, but one that should never have been tolerated by those in charge of the public specimens in a national museum.

That cold meals agreed with the Fanua Loans was evidenced by their appearance—they were a handsome people. When we visited them in January, 1841, they were living anterior to their "stone age;" no one of them, it is probable, had ever seen a stone, or a stone implement of any kind; the smallest stone to them would have been as great a curiosity as a *coral tree* would be to a Dakota Indian on our prairies! Their hardest edge tools were made of sharks' teeth or chama shells, yet their carving was not bad; their canoes, stools and boxes, &c., were neatly smoothed with sharks' skins on wooden handles, forming rasps of various shapes to suit the work to be done. They had a well, and a sea wall built of coral rock.

We obtained from them very neatly plaited rush mats used for clothing, &c., but saw no tapa or bark cloth, so common on the volcanic islands of the Pacific ocean.

The thunder of our cannon, when measuring the island by sound, when explained to them, did not create half the alarm created by a lighted cigar, which in their understanding could not bear any explanation, and no persuasion on either of our visits could induce them to approach it.

Now, after forty-two years, and when foreign missionaries have dwelt there, this plain statement of a little fact about fire, will perhaps be as new at Fanua Loa as similar facts will be about cannibalism on other islands where they have been taught to con-

sider it disgraceful to their ancestry. But facts are always of interest in the history of any people, however civilized they may become.

The natives of most of the Polynesian islands, I believe, are willing and capable of the highest grade of improvement in civilization, under proper treatment by nations of greater power and higher mental attainment.

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GRAVE MOUNDS IN NORTH CAROLINA AND EAST TENNESSEE.

BY DR. CYRUS THOMAS.

BELIEVING that the description of a new class of grave mounds, recently found in North Carolina and East Tennessee, may be of interest to the readers of the AMERICAN NATURALIST, I send, by permission of the chief of the Bureau of Ethnology, the following extract from my report of the mound explorations of the past season.

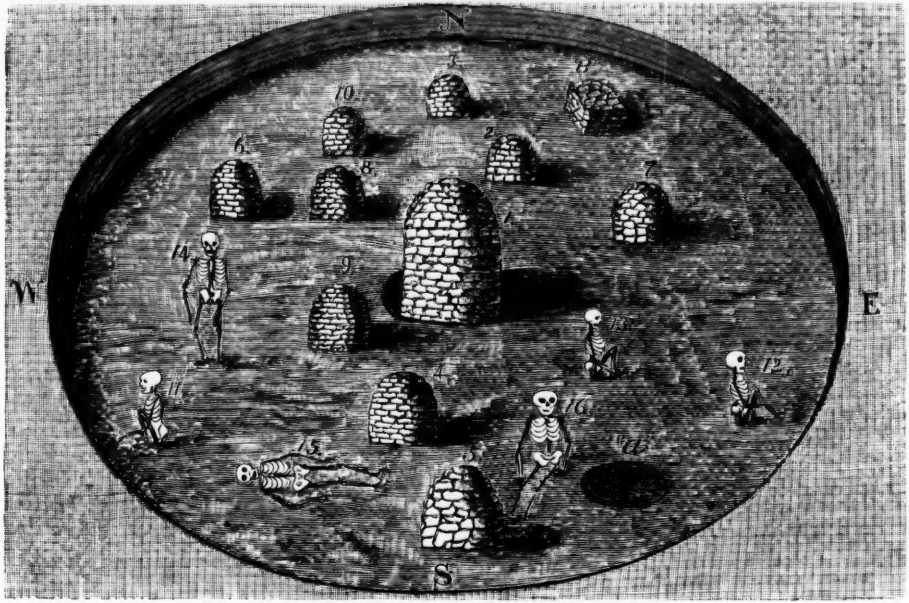
"*The Nelson Mound.*"—This mound, so insignificant in outward appearance as scarcely to attract any notice, was located (for it no longer exists) on the farm of Rev. T. F. Nelson, in Caldwell county, N. C., on the bottom land of the Yadkin, about one hundred yards from the river bank. It was almost a true circle in outline, thirty-eight feet in diameter, but not exceeding at any point eighteen inches in height. The thorough excavation made revealed the fact that the builders of the mound had first dug a circular pit, with perpendicular margin, to the depth of three feet, and thirty-eight feet in diameter, then deposited their dead in the manner hereafter shown, and afterwards covered them over, raising a slight mound above the pit.

A plan of the pit, drawn at the time (after the removal of the dirt), showing the stone graves and skeletons, is given in Plate VIII.

The walled graves or vaults and altar-shaped mass were built of water-worn boulders and clay or earth merely sufficient to hold them in place.

No. 1, a stone grave or vault standing exactly in the center of the pit. In this case, a small circular hole, a little over three feet in diameter and extending down three feet below the bottom of the large pit, had been dug, the body or skeleton placed perpendicularly upon its feet and the wall built up around it from

PLATE VIII.



Appearance of Rev. T. F. Nelson Mound, after excavation.

the bottom of the hole, converging, after a height of four feet was reached, so as to be covered at the top by a single soapstone rock of moderate size. On the top of the head of the skeleton, and immediately under the capstone of the vault, were found several plates of silver mica which had evidently been cut with some rude implement. Although the bones were much decayed, yet they were retained in position by the dirt which filled the vault, an indication that the flesh had been removed before burial, and the vault filled with dirt as it was built up.

Nos. 2, 3, 4. 5, 6, 7, 8, 9 and 10, although walled around in a similar manner, were in a sitting posture on the bottom of the pit. In the grave of No. 2 was found a polished celt; in that of No. 3 a single discoidal stone; in that of No. 6 two polished celts, and immediately over No. 9 a pitted stone.

Nos. 11, 12 and 13 are three skeletons in a squatting posture with no wall around them, and unaccompanied by relics of any kind.

Nos. 14 and 15 are two unenclosed skeletons lying horizontally at full length. With the former some pieces of broken soapstone pipes were found, and with the latter one polished celt.

No. 16, an unenclosed squatter, was of unusually large size, not less than seven feet high when living. Near the mouth was an uninjured soapstone pipe; the legs were extended in a south-east direction upon a bed of burnt earth.

The faces of all the squatting skeletons were turned away from the standing central one.

At "*a*" was found a considerable quantity of black paint in little lumps which appear to have been molded in the hull of some nut. At "*B*" was a cubical mass of water-worn boulders, built up solidly and symmetrically, twenty-four inches long, eighteen inches wide and eighteen inches high, but with no bones, specimens of art, coal, ashes, or indications of fire on or around it. On the contrary, many of the stones of the vaults and the earth immediately around them bore unmistakable evidences of fire; in fact the heat in some cases left its mark on the bones of the enclosed skeletons, another indication that the flesh had been removed before burial, either by previous burial or otherwise.

Scattered through the dirt which filled the pit were small pieces of pottery and charcoal. The bottom and sides of the pit were so distinctly marked that they could be traced without difficulty.

This mound stood about seventy-five yards south of a triangular burial-pit described elsewhere.

"*The Jones Mound.*"—This mound, situated on the farm of Mr. W. D. Jones in the same county, was found, upon investigation, to be similar in form and construction to that just described. It was circular, thirty-two feet in diameter and but one foot in

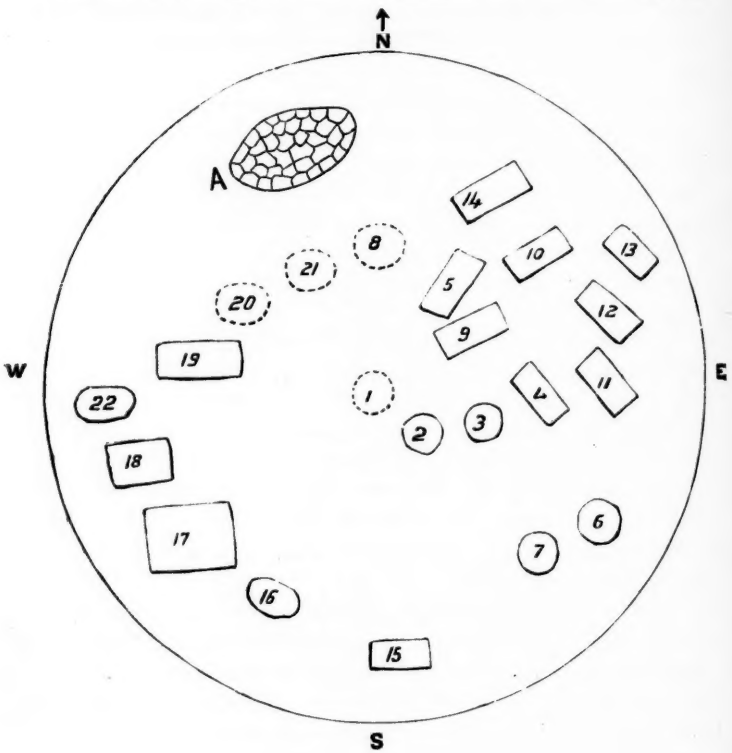


FIG. 1.—W. D. Jones Mound, Caldwell county, N. C.

height; the pit was also circular, thirty-two feet in diameter and three feet deep. The bottom in this case was of clay which had been baked hard by fire to the depth of two or three inches.

In this mound were found twenty-five skeletons and one stone heap, the relative positions of which are shown in Fig. 1.

No. 1. A "squatter," walled in with water-worn stones; the face turned toward the west; no relics.

No. 2. Sitting with the face toward the center; two polished celts at the feet, and immediately in front of the face a cylinder of hard gray mortar (not burned), about five inches long and two inches in diameter with a hole through one end.

No. 3. Sitting, with the face toward the center; several polished celts at the feet.

No. 4. Horizontal, head southeast, several celts at the feet.

No. 5. Horizontal, head toward the center; several celts at the feet.

No. 6. Facing the center, sitting; shell beads around the neck, a Unio shell on top of the head with the concave surface down, a "conch shell" (*Pyrula perversa*) in front of the face, and celts at the feet.

No. 7. Sitting, facing the center, celts at the feet.

No. 8. Very large, lying on the left side, legs partially drawn up, walled in with boulders; no implements.

No. 9. Horizontal, face down, head toward the center, celts and discoidal stones at the feet, and a pot resting, mouth down, upon the head.

No. 10. Horizontal, face up, feet toward the center, pot resting on the face, stone implements at the feet.

No. 11. Horizontal, head south-east, arms extended and a bracelet of copper and shell beads (alternating) around the neck; face up with a food cup (without handle) at the right side of the head.

No. 12. Horizontal, face up, head south-east, shell beads around the neck, a hook or crescent-shaped piece of copper on the breast and a soapstone pipe near the face. One hand near each side of the head, each grasping small conical copper ornaments (ear drops) and a small bunch of hair. Was this individual, possibly a female, buried alive?

No. 13. Horizontal, on the back, head south-east, copper and shell beads around the neck and wrists, a hook or crescent-shaped piece of copper on the breast, a food cup (with handle) lying on its side with the mouth close to the face, a pipe near the mouth and two celts over the head.

No. 14. Horizontal, lying on the back, head north-east, arms extended, each hand resting on a shell which had evidently been engraved, though the figures were almost totally obliterated.

No. 15. Horizontal, on the back, head west, knees drawn up, stone implements at the feet.

No. 16. Too much decayed to determine the position.

No. 17. Four skeletons in one grave, horizontal, heads toward the east and large rocks lying on the legs below the knees; no implements.

No. 18. Two skeletons in one grave, heads west, faces down, knees drawn up; no implements.

No. 20. Sitting, with face toward the east, walled in, a large rock lying on the feet (though this may have fallen from the wall); no implements.

No. 21. Sitting, walled in, over the head, but under the cap-stone of the vault, a handful of flint arrow-heads.

No. 22. Doubled up with the head between the feet.

"*A*." A solid mass of boulders, oval-shaped, thirty-two inches long, twenty-two inches wide and twenty-four inches high, resting on the bottom of the pit. No ashes or other indications of fire about it.

Fragments of pottery, mica, galena, charcoal, red and black paint and stone chips were found scattered in small quantities through the earth which filled the pit. All the celts were more or less polished.

"*The Lenoir Burial Pit.*"—This is a circular burial pit similar to those described, but level on the surface. It is on the farm of Mr. R. T. Lenoir, same county. A diagram is given in Fig. 2. Diameter twenty-seven feet, depth three and a half feet, almost a perfect circle, sides nearly perpendicular. The dirt in this case, as in the others, was all thrown out.

No. 1. A bed of charred or rather burnt bones, occupying a space three feet long, two feet wide and about one foot deep. "The bones were so thoroughly burned that it was impossible to determine whether they were human or animal." Beneath this bed the yellow sand was baked to the depth of two or three inches. Under the bones was a shell gorget.

No. 2. A skeleton in a sitting posture facing north-east, a pipe near the mouth and a polished celt over the head.

No. 3. Sitting, facing east, with shell beads around the neck and also around the arms just below the shoulders.

No. 4. Horizontal, on the back, head east and resting on the concave surface of an engraved shell, "conch shell" (*Pyrula perversa*), at the side of the head, and copper and shell beads around the neck.

No. 5. Horizontal, head north-east, shell beads around the neck and two discoidal stones and one celt at the feet.

No. 6. A communal grave containing at least twenty-five skeletons, in two tiers, buried without any apparent regularity as to direction or relative position. Thirteen of the twenty-five were "flat-heads"—"that is, the heads running back instead of up in the ordinary way."

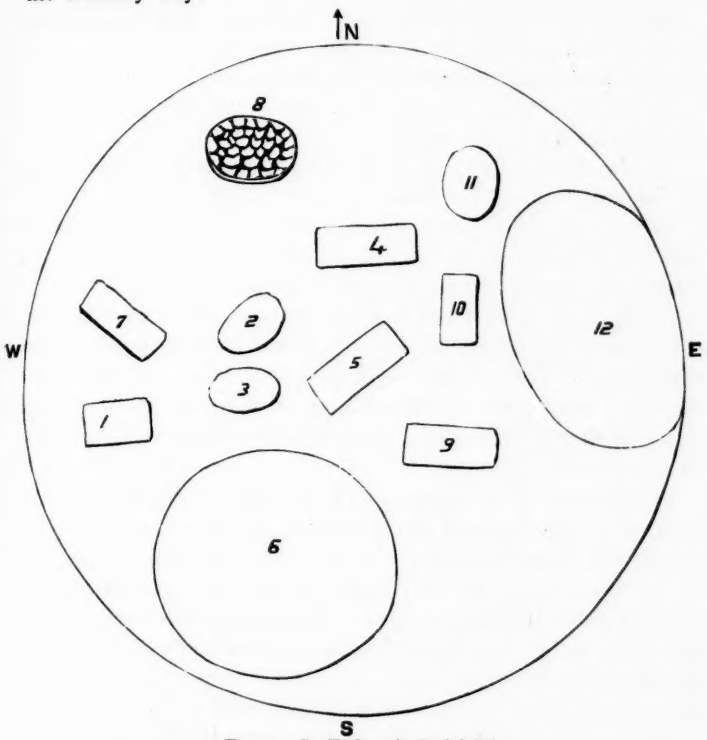


FIG. 2.—R. T. Lenoir Burial Pit.

Scattered through this grave, between and above the skeletons, were polished celts, discoidal stones, shells, mica, galena, fragments of pottery and one whole pot. Around the neck and wrists of some of the skeletons were also shell beads. There may have been more than twenty-five individuals buried here, this, however, being the number of skulls observed.

No. 7. Horizontal, on the left side, head north-east; no implements.

No. 8. An irregular layer of water-worn stones about four feet square. On top was a bed of charcoal three or four inches thick, on and partially embedded in which were three skeletons, but showing no indications of having been in the fire. Scattered over these were discoidal stones, one small saucer-shaped dish, shells (one of which is engraved), pipes, shell beads and pieces of pottery.

No. 9. A grave containing three skeletons, lying horizontally on their backs and side by side; the outer ones with their heads east and the middle one with the head west; no implements.

No. 10. Horizontal, on the right side, head north, with stone implements in front of the face.

No. 11. Doubled up, top of the head south, shell beads around the neck and celts at the feet.

No. 12. A grave containing seventeen skeletons, seven of which had flat heads, two of the number children. Two of the adult heads were resting on engraved shells.

In this grave were found four pots and two food cups, the handle of one representing an owl's head and that of the other an eagle's head. One of the small pots was inside a larger one. Scattered among the skeletons were shell beads, polished celts, discoidal stones, paint, &c. None of the skeletons were enclosed in stone graves.

For the purpose of comparison I will now give the description of a single mound found on the bank of the Holston river, Sullivan county, East Tennessee. It is circular in form, thirty-eight feet in diameter and five feet high; on the top was a pine stump fourteen inches in diameter, the tree having been cut down twenty-five years ago. This mound differed from those described in having no pit below it; but in it, built on the natural surface of the ground, was a circular wall of cobble stones, three feet high, enclosing a space fourteen feet in diameter. Inside of this were twelve stone graves similar to those shown in Plate VIII, one of them in the center and the other eleven equally spaced around near the wall, as shown in Fig. 3.

The surface of the area enclosed by the circular wall was covered to the depth of three inches with charcoal and the graves built on this layer.

Each grave contained a single sitting skeleton; around the neck of the central one were shell beads, and near the mouth a

finely polished pipe of green syenite; no relics were found in any of the other graves.

It is only necessary to add that these mounds and burial pits were opened by the regular assistants of the Bureau of Ethnology, and that all the articles mentioned, except the skeletons, are now in the National Museum. Some of the skulls have also been received, but most of the skeletons were so badly decayed that when exposed to the air they crumbled to pieces.

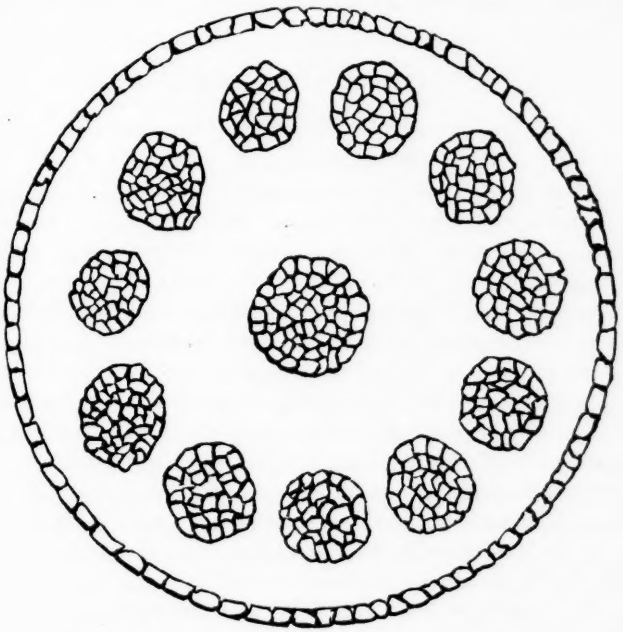


FIG. 3.—Mound on Holston river, Sullivan county, Tenn.

I give here a list of the articles obtained from one of these burial places, the "Lenoir Burial Pit":

One stone axe; forty-three polished celts; nine vessels of clay; thirty-two arrow-heads; twenty soap-stone pipes, mostly uninjured; twelve discoidal stones; ten rubbing stones; two hammer stones; one broken soapstone vessel; six engraved shells; four shell gorgets; one *Pyrula perversa* entire, and two or three broken ones; one iron celt; five very large copper beads; one lot of fragments of shells, some of them engraved; a few rude shell pins;

shell beads; a few small copper beads; specimens of paint and plumbago; three skulls.

I am inclined to believe that these mounds are the work of the Cherokees, but cannot give my reasons for this belief in this article. Somewhat similar burials found in Kentucky point to the region of the Ohio as the former home of the builders of the North Carolina and East Tennessee mounds. It is possible, therefore, that further research will tend to confirm the Cherokee tradition mentioned by old John Lederer.

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COLONIAL ORGANISMS.

BY CHARLES MORRIS.

(Continued from page 149.)

A CONTINUED review of the subject of animal colonization leads next to the Annelida and the Arthropoda as its most advanced instances. This progression, indeed, is not so strongly marked in the Annelida, which are usually not only distinctly segmented, but each segment is an almost complete individual. Each segment possesses its own nerve fibers and ganglion, its own muscles, its own limbs, frequently its own breathing organs, and, in a partial degree, its own circulation. The intestines of the several segments unite into a common intestine. Indeed this retention of individuality, in some cases, goes still further. There are existing worms which possess eyes in each separate segment. Thus the indications are very marked that the Annelid began life as a colony of budded individuals in which subordination of some of the life functions had taken place. This subordination is yet, in many instances, very slight, the only distinctly specialized segment being the head, with its mouth and sense organs. The loss of individual completeness is not nearly so great as in the members of the Siphonophora.

In its reproductive phenomena the family of segmented worms presents some striking evidences of a colonial origin. In certain instances the worm is born as an individual segment, and gains its mature state by subsequent budding. This is the case with the tape worm, in which the budding process continues indefinitely throughout life. Among the Chætopoda some very significant phenomena are exhibited. A single worm is divided into two through fission between two of the body segments, one of

which becomes the anal region of the anterior worm, and the other develops into the head and several succeeding segments of the posterior worm. The anal region may, by growth and segmentation, give rise to an indefinite number of new segments. In the fresh-water worms, the Nais and Chætogaster, this phenomenon proceeds farther. After the division into two worms and subsequent growth by segmentation, fission again and again takes place, whenever four or five new segments are added in front of an anal zone, so that a chain of zoöids is formed, each with a few segments only and all fed from the mouth of the anterior one. Subsequently they break up into free individuals, each of which lengthens by budding.

This phenomenon strongly indicates an original possession of the full life functions by a single segment which formed, by asexual reproduction, a longitudinal colony. Each member of this colony, while subordinated in function, tends to complete development, as is shown by the fact that certain segments apparently regain lost organs and resume discarded functions. The seeming indications is that these organs and functions were part of their original life plan, and that their ordinary development is only a partial one.

In fact, in all these cases of individuals developed from colonies, the segments or organs present certain analogies to the larval state of other animals. The larva is an instance of retarded development in which the surrounding conditions check for a time the further unfoldment of the life plan, and cause the assumption of new temporary organs or functions. In the segment the unfoldment of the life plan is in like manner checked, and occasionally new organs or functions are developed to bring the organism into harmony with surrounding conditions. Ordinarily the larva enters into new conditions and resumes its checked development. Ordinarily the segment fails to enter into new conditions, and its development continues partial. Yet there are interesting instances in which the larval retardation continues for life, as in the Leptocephali, or embryonic fish.[1] And to complete the analogy we have the above interesting instance of the Chætopoda, in which the developmental energies of the segments appear occasionally to triumph over the retarding conditions, and

[1] See paper on "Growth and Development," AMER. NATURALIST, July, 1883, p. 725.

to cause a nearly complete unfoldment of the original life plan. The main difference between the larva and the Annelid segment, or the Hydrozoan organ, is, that in the former the animal is checked in an embryonic stage, in which it possesses full life functions; in the latter it attains its mature stage, but with only a portion of the life functions. In the former it displays an independent immaturity, in the latter a subordinated maturity. But with these distinctions we seem to behold in all these phenomena the results of one law of nature, a checked development, under the force of circumstances, of forms which have an innate tendency to complete their development, which tendency becomes effective as soon as the retarding conditions are removed, and at times seemingly in spite of them. There appears to be a persistent strife between the active external conditions and the innate hereditary life energies.

The embryological development of the Annelids presents indications like those of the Hydrozoa. They leave the egg as globular masses of untransformed cells. This cell mass elongates and becomes segmented, while the head organs appear anteriorly. The number of segments increases by the interposition of new ones, the segmental organs appear, and the young animal gains the mature form. In this process the indication of an original colonial origin is evident, though perhaps less so than in the Hydrozoa. The asexual budding by which the mature animal is formed is certainly significant, and points to the character of its phylogenetic derivation.

In the Arthropoda appears the highest known development of this principle of the formation of individuals by the transformation of colonies. Of these the Myriopoda alone present clear indications of colonization. In them the segments are as similar to each other as in the Annelida, and like the latter possess nearly all the life organs. Each segment has its own nerve ganglion and fibers, its breathing organs, muscles, intestine and vascular space. It lacks only the mouth and the sense organs of the head-segment to be a complete animal. And its formation by the indefinite budding of new segments is significant of its origin.

In the Crustacea, Insecta and Arachnida, the traces of the original colonial condition are much less evident, though they are ordinarily quite manifest in Crustacean and insect larvæ. And

even in the highest of the Arthropoda, the insects, the original individuality of the segments is not quite lost in the mature state. The primitively individual members of the colony stubbornly resist the cession of their separate functions, and only partially yield to the common needs. This persistent individuality of the segment is partly manifest in their legs and wings, which are appendages of separate segments; but more particularly in the segmental succession of their nervous, muscular and respiratory organs, and in their segmented chitinous armor. Indeed, the Crustaceans and Insects indicate a lateral as well as a longitudinal development of individual segments, for the limbs present significant traces of an origin in the budding process. They appear, in fact, to be a series of specialized segments which have become greatly degraded from their original organic completeness through disuse of the internal organs. Each possesses its muscles, its chitinous armor and what may represent its intestinal cavity. The successive joints of the limbs appear to result from a continuance of the budding process. This seems evidenced by their power of reproduction by budding, when broken off at the joint, and also by the lateral budding which frequently takes place at the extremities of the limbs.

As for the reproduction of the Arthropoda, it tends to disguise their colonial origin, yet only partly so. They are usually born as partially developed colonies, resembling the Annelida in general configuration. But this merely indicates an acceleration of development, or an embryological growth to a considerable extent through the aid of maternally-provided nutriment. In the highest insects, the ants and bees, the parental care is continued until maturity. The growth of the embryo from nutriment provided by the maternal body in no essential sense differs from its continued growth from nutriment provided by the workers, and it is not thrown upon its own resources until maturity. This is the final and highest outcome of the colonial method of animal formation, one in which the members of the colony have become so welded together and subordinated as to have almost vanished from observation, and in which the young begins its individual life in the mature state.[1]

The review we have here given of the method of development of individual animals through a process of colonization, and the

[1] For a somewhat different consideration of this topic see "The Evolution of Organic Form," *Popular Science Monthly*, Nov., 1880.

reduction of the members of the colony to the condition of organs of an individual, may be briefly concluded and perhaps strengthened by a reference to the sub-kingdoms of animals whose members appear to develop as individuals and not through colonization, and whose organs arise from special modification of the tissues of the individual body, and not from subordination of the separate members of a colony. There are three of these sub-kingdoms, the Echinodermata, the Mollusca and the Vertebrata. Of these, indeed, the first is supposed by Haeckel to arise from a colony, since he ascribes the star-fish to the original junction of five worm-like animals. The evidence in favor of this, however, is not convincing, and is not sustained by any distinct evidence of budding in the development of the embryo. In regard to the Mollusca their individual derivation is unquestionable, and their organs present no indication of assuming the typical molluscan form. The segmental character of a part of the body of the Vertebrata has been adduced as an argument in favor of their colonial derivation, but this argument is unsustained by any other evidence. There is no indication of segmentation in the organs, none of which are successively repeated, as in the Arthropoda and Hydrozoa. These organs indeed present every indication of originating in the transformation of the tissues of an individual, and display no evidence whatever of a tendency to assume the parental form. The only indication of colonial aggregation is in the segmental repetition of the vertebrate bones and their accompanying nerve ganglia, but this segmentation may perhaps be better explained in another manner.[1]

In vertebrate embryology there is no clear evidence of segmentation; and the lowest vertebrate, the lancelet, possesses the vertebral characteristics very imperfectly. The Tunicata yield some indication of a connection with the Vertebrata by the segmentation of their posterior body in the embryo state, but this very low stage in the line of vertebrate development is utterly unlike the accordant stage of articulate development. In the latter each segment is furnished with nearly all the organs necessary for individual life. In the former the functional organs develop within the anterior undivided body, and the segmentation is limited to the tissues of the tail, and is perhaps due to the need of flexibility in the swimming motion of a homogeneous organ.

[1] See "Evolution of Organic Form," *Pop. Science Monthly*, Nov., 1880.

As for the reproductive phenomena of the animals here considered, there is no essential distinction from those of the colonial class. In the low forms the young are born immature, in the high forms they are born mature, but in all cases their real birth is as a single cell into the ovary, while the after development is gained partly within the maternal body or the egg, partly in the external world. Yet in this respect the highest vertebrate presents an interesting parallelism with the highest arthropod. As the ants continue to feed the embryo after birth until it has assumed the mature form and is able to obtain its own subsistence in the method of the mature animals, the same may be said of the birds and the Mammalia, which continue to supply their young with food after birth until they are able to provide for their own needs in the parental method. Thus at the summit of the organic series the young begins its individual life as an animal mature in every function except the reproductive.

The colonial origin of the higher plants is equally significant with that of the animals mentioned. As compared with the animal world their closest analogy is with the colonies of the fixed Hydrozoa, in which, from a common stem attached to the surface, outgrow successive nutritive and reproductive individuals. This description applies exactly to the highest plants, with the exception that they are attached to the ground by roots, which are also transformed individuals.

Even the escape of the reproductive members of the Hydrozoan colonies as free Medusæ is not without its analogies in the vegetable world, whose shed spores become reproductive individuals. The fact is that all high development in plants is attained by the method of colonization, and that the advancement in this direction is far inferior to that gained by the higher animal colonies.

The lower sub-kingdoms of plants are not clearly distinct from cell colonies. They are born as single cells, which subsequently develop into cell masses. These, particularly in some of the higher Fungi, become very complexly organized, yet they display little or no cell differentiation, and may properly be considered as cell colonies. The spores, which are shed by all the lower orders of plants, are free asexual offspring probably peculiar only in being specially rich in protoplasm, and thus well adapted to active growth. Such an asexual growth takes place

in the spores of all plants from the Fungi to the Ferns, and sexual propagation arises through a combination of two cells produced by this secondary growth.

As the gastrula seems to be the primitive form of the many-celled animal, so we might reasonably look for some parallel typical form in plants. In all higher plants the leaf is the most apparent fundamental form. Yet the leaf is the result of a considerable degree of evolution, and is preceded in the lowest plants by a mere mass of undifferentiated cells which assumes no typical form. There is no requirement of a digestive cavity to which the fundamental form of animals is due. This cell mass assumes the leaf shape in some of the Algæ. In the mosses the leaf becomes more definitely organized, and still more so in the ferns, but gains its highest condition only in the phanerogams. The embryological development passes through conditions analogous to those of animals. Birth consists in the extrusion of a single cell which, after fertilization, develops into a cell colony, and subsequently, in the higher plants, produces embryo leaves, stem and root in its ovarian development. In all plants a mass of unorganized tissue represents the early cell colony, while the leaf and the flower appear in the higher plants as the ultimate results of vegetable evolution. But these higher plants are in no proper sense individuals. They are colonies of but slightly subordinated members. The mosses, the ferns and their congeners, are little more than leaf colonies. An Endogen is an organic colony, each of whose members is a single leaf. In the Exogen the final step of progression is made, and the individual member of the colony is a group of leaves, attached alternately to an unbranched stem.

In all plant colonies a stock-mass or stem is formed, which serves as a reservoir of nutriment and a vascular organ. In the mosses and lower ferns this stem lies under ground, while the germs which it produces unfold into colonies of individual stems or leaves. The colonies are annually reproduced, and each adds something to the dimensions of the stock mass, which, in the higher ferns, emerges from the ground, and gradually extends upwards into the air. This fern stem has no power of self-growth. It is made up of the bases of old leaves, of vascular bundles which serve to supply the new leaves with nutriment, and of aërial roots which grow abundantly from its sides, and add much to its thickness.

In the Endogen the colonial character of the tree is equally or perhaps yet more evident. The stem is, as it were, a fertile soil, in which annual colonies of leaf individuals take root. For the leaf is not properly an organ of the tree, but is an individual which is rooted in the tree, as the tree itself in the soil. The vascular bundles or the root fibers of the leaves force their way far down into the trunk, as if in search of nutriment, and thus add new tissue to the stem throughout its whole length. Neither in the Fern nor the Endogen has the stem any power of self-growth (except in some special instances), there being no germinal tissue except at the extremity of the stem. The tree fern adds new tissue mainly to the extremity of the stem, which increases in diameter only by the outgrowth of adventitious roots. The Endogen, by the downward growth of vascular bundles from the leaves, adds new tissue throughout the stem, which in consequence becomes exceedingly dense and hard, but which has no growth in diameter.

In the Exogen other features of progression appear, and the colonial character has become less evident. The individual member of the Exogen colony is no longer a single leaf, but a group of leaves, seated on an unbranched connecting stem. And the vascular bundles proceeding from these leaves can be traced but a short distance into the substance of the stem. The members of the colony seek less for individual service by aid of their fibrous roots, but trust more to the general vascular service of the stem. This service is more easily performed from the fact that the exogenous trunk retains active tissue throughout its whole length. Thus cell reproduction is constant, and the stem increases annually in diameter. In addition the presence of germinal tissue throughout the stem permits asexual reproduction elsewhere than at the apex, as in Ferns and Endogens, and reproductive buds may be formed at any point in the cambium layer. Thus the Exogen, though a colony in origin, has made a decided movement towards a composite individuality, though it is far from having attained the definite individuality attained by the higher animal colonial groups.

We have, thus far, considered only the leaf members of the plant colony. There are two other members, the root and the flower, both produced by asexual budding, the former representing an earlier stage in vegetable evolution than the leaf, the latter

the most highly evolved members of the plant colony. The plant stem which connects these individuals resembles the stem of the Cœlenterate colony in its vascular function. But the plant colony has the peculiar feature that it includes two distinct forms of nutritive individuals, each absorbing a special kind of nutriment. The water and the nitrogenous elements of the food are absorbed by the roots, the carbonaceous by the leaves. Just where the chemical combination of these various elements into protoplasm takes place, whether in the leaves or the stem, is not known.

It appears, from these considerations, that the tree is not a colony in a simple sense, as in the Polyzoa, in which precisely similar individuals are aggregated; but in a complex sense, as in the Hydrozoa, in which each individual performs but a part of the life functions, and is dependent upon other individuals for the remainder. Thus the tree is, in one sense, an individual, with three kinds of organs, but in a truer sense, a colony of partly subordinated individuals.

The third form of organ, or member of the colony, the reproductive, is in its origin a modified leaf group. It has no nutritive powers, its sole duty being sexual reproduction. This reproductive function we need to consider in conclusion. The plant colony, like the animal colony, is built up by asexual budding. These buds, in the higher plants, attain a considerable degree of development ere their individual life begins. They enter upon their life duties neither as simple cells nor as simple leaf organs, but as leaf colonies. Thus the product of a Phanerogamous bud is not a single leaf, but a group of leaves, each of which, however, retains its individuality in the Endogens, but loses it in great measure in the Exogens, in which the twig with its leaves acts as a compound individual. This is another instance of "Acceleration of Development," an advanced degree of development being attained under the parental care, ere the offspring is thrown upon its own resources as an active individual.

In regard to the sexual individuals a still more declared acceleration is evident. In this respect the history of plants runs parallel with that of animals. In the lowest forms the product of sexual "conjugation" is a single cell, which is at once thrown upon its own resources for development. In somewhat higher forms, as in the higher Fungi, asexual germs, perhaps rich in protoplasm, are shed as free individuals, and grow into the fila-

ments of the mycelium ere sexual reproduction takes place. There seems here a preliminary gathering of nutriment for the use of the sexual germ. In the Ferns this process is repeated in a fuller degree. The asexual spore develops into a *proembryo*, or mass of cell tissue, within which arise the ova and spermatozoa of sexual reproduction. Thus the new-born sexual germ is provided with a stock of nutriment to aid in its embryo development, and the proembryo is in this sense the primitive form of the seed of the higher plants. It, indeed, in a fuller sense, represents the flower of the higher plants, since it acts as a reproductive organ, and produces fertilized germs.

But in the Phanerogams the development of the embryo under the parental care proceeds considerably farther than in the Cryptogams. The young is not shed as a germinal cell, nor as a mass of unorganized cell tissue, nor even as a leaf colony as in the asexual bud, but as a mature plant, with stem, leaf and root all clearly indicated, and surrounded by a store of nutriment to aid in the early stages of its subsequent growth. Thus the seed of the plant is directly parallel to the egg of the animal, and acceleration of development has attained to as high a stage in the one case as in the other. In the highest phases of both plant and animal life the young begins its individual life as a copy of the mature form. In the seed of the Endogen the simple nature of its individual is apparent in the presence of a single seed-leaf, while the double, or the yet more numerous cotyledons of the Exogens, point to the composite character of the exogenous individual.

This paper has grown to too great a length, and yet the subject is but briefly treated. A fuller consideration could have included many other facts in aid of the doctrine of the colonial origin of the organisms reviewed, and also have made more apparent the fact that the organs of individually-developing classes of animals, as the mollusks and the vertebrates, present no indication of a tendency to assume the typical form of the animal, as required by the opposite theory. It is offered but as a partial contribution to the subject, with little value beyond its extension of the inquiry to the whole field of animal and vegetable life, and possibly its effort to place the phenomena of reproduction, and the essential distinctions between the Protozoa and the Metazoa, in a somewhat clearer light.

ANATOMY AND PHYSIOLOGY OF THE FAMILY NEPIDÆ.[1]

BY WILLIAM A. LOCY.

THE value arising from a study of the organs and their functions in any animal, is not limited to a knowledge of the form studied nor to the facts obtained. The general principles of comparative anatomy and physiology will be thus developed, since they exist in the study of the bodies of all animals, and furthermore, the study of a typical form will furnish a key to a more special knowledge of a whole group, just as a type language affords a key to a group of languages. In studying the anatomy and physiology of the family Nepidæ, then, results are obtained which reach far beyond the boundaries of the family, and which constitute simply special cases to illustrate the principles of comparative anatomy and physiology.

The functions performed by the organs of animals' bodies naturally fall into three groups, nutrition, reproduction and relation, which will form special divisions of this subject to be treated after considering a few generalities.

Methods of work, etc.—The more general methods are briefly considered here, the special methods, when requiring mention, are spoken of in connection with the work for which they are designed.

To dissect successfully the Insecta, it is necessary to work under water or some other transparent liquid, therefore a dissecting slab and a tray are essential. The former is easily made by loading cork or soft wood until it will sink under water; it is better to paint this black to furnish a good background, since the tissues of insects are usually white. Any vessel of convenient size will serve as a tray.

In opening the specimen, which may be done along the median line or at the side, care should be taken to cut simply the integument, which, before cutting, should be raised with the forceps and carefully freed from all attachments. The insect is then to be pinned out upon the slab and dissected under water or alcohol.

The working outfit necessary is neither costly nor extensive, the apparatus just described and the following will be found adequate for all ordinary work: (1) A pair of fine scissors with

[1] Thesis to obtain the Degree of Master of Science, submitted to the University of Michigan.

curved points; (2) a fine scalpel for general cutting; (3) needles mounted in wooden handles are very convenient for separating the tissues and removing small portions piecemeal, these ground to an edge and sharpened form very fine cutting instruments; (4) fine pliers or forceps; (5) a good pocket lens, or better, a dissecting microscope. For all histological work and fine anatomy, a good compound microscope which, however, need not cost more than $35 or $50, is necessary.

Habits, etc.—The family Nepidæ, of the Hemiptera, is represented in our waters by four distinct genera, Belostoma, Perthostoma, Nepa and Ranatra. They are of common occurrence in the ponds and streams about Ann Arbor, except Nepa, which is rarely found. The first three mentioned are flattened and oval in outline, while Ranatra is remarkable for its long linear form.

Belostoma and Perthostoma, the most active forms, have their hind legs admirably fitted for swimming. Ranatra and Nepa, to correspond with their habits, have their hind legs fitted for crawling along the bottom and upon aquatic plants. The fore legs of all the genera are raptorial and armed with a terminal claw. In Ranatra this fits into a groove in the tibia, as the blade of a knife fits into the handle. In the other genera the femur is grooved to receive the fore leg, and the trochanter, the terminal claw. The prey is seized by these raptorial legs and conveyed to the mouth; it is here punctured by the three-jointed beak and the nutriment sucked out. Their food consists of the juices of larval insects, tadpoles, young fish, gasteropods, etc. In Ranatra and Nepa the antennæ are three-jointed, in Belostoma and Perthostoma four-jointed, and concealed in a vaulted cavity opening below the eyes.

The adult Belostomæ are very large, ranging from three to four and a half inches in length, and are the brigands of the streams they inhabit. From their rapacious habits they soon exhaust the food from one locality, then fly to another during the night. They attack aquatic forms several times their own size. In an aquarium I remember having once seen a large Belostoma kill a frog four times its size, despite the fierce struggles of the frog to escape.

In general appearance Ranatra resemble the "walking-sticks." The body ends posteriorly in two long setæ, the grooved faces of which, applied together, form a respiratory tube as long as the abdomen. The front legs are very long, and extend straight out

in front of the body, which throws the center of gravity too far forward for convenient flight.

When preparing for flight the air sacs are first inflated, the prothorax and head are thrown downward, and the front legs disposed of in a very ingenious manner. The femurs are bent upon the joint near the head, a little more than 90° from their original position, and the tibiæ are folded closely against these, thus the front legs hang under the body, directed a little backward.

Though of much smaller size, Perthostoma strongly resembles Belostoma in general appearance, but is quite distinct in antennæ, beak and legs. The females of the genus carry their eggs on the back, regularly arranged in a single layer, cemented to the body by a substance insoluble in water. The eggs of the other genera are attached to the water plants and submerged objects.

Belostoma, Perthostoma and Ranatra are infested by a Hydrachna, which is found attached to different parts of the body. This is probably also true of Nepa, but I have not had the specimens to determine. For a fuller account of the external anatomy and the family characteristics, the reader is referred to the works on systematic entomology, while attention is now called to the *internal anatomy.*

A. The Function of Nutrition.

The function of nutrition includes all the processes concerned in preserving the organism of an animal, as the digestion of food, its conveyance to a point for use, the chemical changes of converting food into tissue, and the removal of waste matter. These processes are carried on by the organs of digestion, of circulation, of respiration and of excretion, which form separate subheads for consideration.

I. The Digestive System.

On opening the insect the most prominent set of organs is the alimentary canal and its appendages. The thread-like œsophagus, characteristic of suctorial insects, extends straight from the beak to the metathorax, where it enlarges abruptly into the stomach. The anterior end of the œsophagus is connected with a peculiar pumping apparatus, which will be described later. The division of the digestive apparatus into a distinct crop, chylific ventricle, etc., frequently found among insects, is practically obliterated in these insects; this, indeed, is the case in most of the Hemiptera Sometimes in Ranatra an oval enlargement exists at the begin-

ning of the stomach (Fig. 3) and another at the end not so well marked, but in neither case are they distinctly separate from the rest of the stomach.

The stomach, taken as a whole, is of unusual size, and much saculated by contraction. In the third abdominal segment its pyloric end opens into the intestine. Both stomach and intestine consist of at least two coats, an external muscular coat and an internal mucous coat. The existence of a third coat in the Hemiptera is a disputed point; though Dr. Leidy mentions it in Belostoma, and I have found it, to the best of my belief, in Ranatra.

The muscular coat consists of both longitudinal and annular fibers, the former predominating. The peristaltic contractions of the alimentary canal are due to these muscular layers, and in the insects under consideration these movements are very energetic and thorough, separating the liquid food into chyle and excrementa. The mucous layer extends the entire length of the alimentary canal, and is most easily observed at the pharynx and at the anus.

Before emptying into the cæcum, the intestine is divided into an anterior and posterior portion by a bulbous enlargement, upon which the Malpighian tubules are situated. The first part may be conveniently called the duodenum, as some authors call it, and the after part the ilium. The duodenum is convoluted upon itself several times. In Belostoma it turns from its origin, first to the left, then upward, running along the left side of the stomach to about one-third its length, then turning upon itself, returns to the median line of the body; from this point it passes upward on the right side of the stomach, turns with an irregular loop and reaches again the median line, where it enlarges into the bulb. The tissues of the duodenum are the same as those of the stomach.

The ilium is slightly larger than the duodenum and coils upon itself five or six times in a sigmoid manner. In the greater number of specimens dissected, the coils were six in number. The ilium empties into a cylinder larger than itself, which represents the colon or rectum. The upper portion, which is separated from the lower by a slight constriction, is sometimes considered as representing the colon, and the lower portion the rectum. This latter diminishes rapidly, and ends in a pointed opening at the anal aperture, which is situated above and behind the genital orifice.

From the colon a large cæcal pouch extends forward, beneath the intestine, reaching in its ordinary condition to the middle of the fourth ventral segment. This is the cæcum. It is sometimes so distended with air as to reach even to the thorax, and to give a bloated appearance to the usually flattened ventral surface of the insect. This organ probably plays the same part as the air bladder of some fishes, serving as a natatory vesicle. I have often seen these insects come to the surface and forcibly expel the air from the cæcum. When the abdomen is just below the surface, the water is thrown upward in jets by the discharged air. I have also noticed the larvæ of Belostoma, when irritated, throw from the anus jet after jet of a strong smelling, light-greenish fluid, the propulsive force of which probably comes from the cæcum.

Frequently when the insects have died in water, the cæcum, naturally white, is found swelled and of a dark-blue or livid color. From the large number of cases in which this has been observed, I think that it is due to some disease. The chief differences in the alimentary canal of Belostoma and Ranatra may be seen by comparing Figs. 3 and 5.

Method of taking Food.—In order to understand how these insects take their food, we must first study the food-taking organ, or the beak. This is a three-jointed tubular structure formed from the modified mouth parts. All masticatory characters are obliterated, the labium is elongated and folded upon itself, forming a sort of trough, which is nearly closed at the top; within this the maxillæ and mandibles are found modified into four bristles which, before entering the trough, pass through a sheath made from the labrum. This sheath projects into the beak, or trough, from above (Fig. 2).

By the action of these bristles the prey is punctured and the food-juices brought to the real sucking organ, the "pharynx." This is a stiff chitinous trough, roofed by a plate of chitine, into which the œsophagus enters from behind. The sides of this trough extend much above the roofing, as shown in a cross section of the apparatus (Fig. 7); from the elevated middle of the roof chitinous threads originate, to which muscles are attached. These extend upward, first in one sheet, then divide into two parts, one going to the left the other to the right, and are attached to the integument of the head. There is no other appa-

rent sucking apparatus in the body, and the only use I can assign to the structure just described, is that of a *pumping organ.* It is probable that the liquid food is sucked into the pharynx by the contraction of the muscles which are attached to the chitinous threads; this process enlarges the pharynx cavity by lifting the roof. From the pharynx the food passes, by muscular contraction, down the œsophagus. [Plates to follow with succeeding number.]

(To be continued.)

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THE CREODONTA.

BY E. D. COPE.

PRESENT knowledge justifies the generalization that, since the Eocene period, the mammalian fauna of the Northern hemisphere has diminished in the number of its species and genera. The Eocene fauna was richer than the Miocene; the Miocene than the Pliocene, and the Pliocene was richer than the modern fauna. With this numerical diminution in species has come increased specialization of structure, which means both greater perfection of mechanism and greater diversity of type.[1]

The order of Carnivora is a universal and well-known factor of the mammalian life of the present period. It was equally so in the Pliocene and Miocene periods. When we come to examine the overflowing life of undoubted Eocene time, we can no longer find mammals which possess the essential characters of the order. The Carnivora are unguiculate gyrencephalous mammalia with a coössified scaphoid and lunar bone of the carpus, called, therefore, the scapholunar bone. They have a grooved astragalus. No scapholunar bone has yet been found in any Eocene mammal in North America, and it is doubtful whether any has been found in Europe. Nevertheless the Eocene fauna did not lack predatory flesh-eaters whose function was like that of the Carnivora of later periods, to restrain the undue increase of all other forms of life. Their variety was greater than that presented by their carnivorous successors on the North American continent, and their numbers were proportioned to the general luxuriance of the life which furnished them subsistence. There were species whose size and powers of destruction equaled those of the bears, lions and tigers of modern times. Species of medium size abounded,

[1] This generalization was published in the Report U. S. G. G. Survey W. of 100th meridian, 1877, IV, p. 385.

while the smaller forms, representing in function the civets and weasels of to-day, were especially numerous.

The systematic position of these animals has been difficult to determine with satisfactory precision, owing to the imperfect knowledge which we possess of their structure. Besides lack of scapholunar bone, they nearly all differ from the Carnivora in their ungrooved astragalus, and their greatly reduced and smooth cerebral hemispheres. Their position then can only be with the Marsupialia or the Insectivora. The superficial resemblances are often to the former order, where the carnivorous types Thylacinus, Sarcophilus, Dasyurus and the opossums, seem to present near affinities, if the structure of the teeth only is to be considered. Laurillard, DeBlainville and Gaudry have, at different times, assigned to them this position. It is true, however, that no one osseous character, except the possession of marsupial bones, has yet been discovered which characterizes the order Marsupialia. It rests chiefly on the characters of its soft parts, especially of the brain and reproductive system. Most marsupials have the angle of the lower jaw inflected; the Eocene flesh-eaters do not. The carnivorous marsupials generally have more than six incisor teeth; the Eocene flesh-eaters have six or less. The marsupials generally have perforated palates; the Eocene forms never display the character. No marsupial bones have yet been found in the Eocene forms (with the possible exception of Mioclænus), so that we cannot yet find the necessary reasons for placing our extinct forms with the order which possesses them. On the other hand the brain was probably marsupial in its internal character, as it certainly was in its external character. Finally, the discovery of the character of the temporary dentition in the Eocene flesh-eaters has added force to the view that they cannot be marsupials. M. Filhol has shown that in Hyænodon there were three temporary molars, and I have proven that there were at least two in Triisodon. There is, according to Flower, but one in the Marsupialia. It is, however, to be remembered that true marsupials, opossums, occur in the Oligocene in both North America and Europe (genus Peratherium Aym.), and that they resemble their Eocene predecessors very much, especially in the constitution and form of the molar teeth.

The comparison with the Insectivora betrays no such fundamental diversities as that with the Marsupialia. The differences

are of minor import, although in particular cases considerable. In spite of their often large size and evidently predatory habits, the Eocene flesh-eaters must be placed with the Insectivora. But as I have already pointed out,[1] they have contemporaries which must go with them. These are two groups, the one with rodent, the other with edentate tendencies, the Tillodonta and Tæniodonta. The former of these is intimately allied to the living Chiromys of Madagascar, which itself is almost a lemur, by gen-

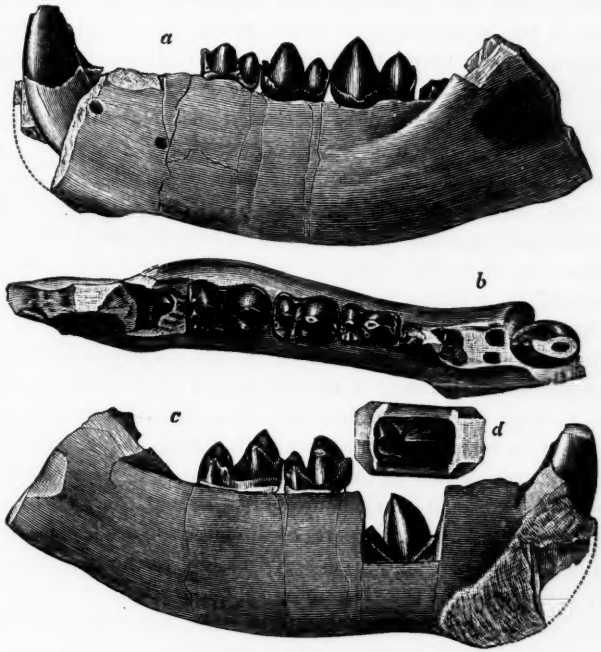


FIG. 1.—Left mandibular ramus of *Tritsodon quivirensis* Cope, three-fourths nat. size, from the Puerco beds of New Mexico. Fig. *a*, external view, displaying the last temporary molar in place; *b*, the same from above; *c*, the same, internal side, the temporary molar removed and the permanent fourth true molar displayed in the jaw; *d*, the fourth permanent premolar viewed from above. Original; from Vol. IV, Report U. S. Geological Survey Terrs., F. V. Hayden in charge.

eral consent. The whole of this assemblage I have regarded as an order of mammals to which I have given the name of the Bunotheria. In this order there are included six suborders, and

[1] Report U. S. G. G. Surveys W. of 100th meridian, G. M. Wheeler in charge, IV, p. 85, 1877. Proceedings Academy Philadelphia, 1883, p. 77.

the carnivorous type of this series, the group now under discussion, I have called the Creodonta.[1] Its definition is as follows:

Neither incisor nor canine teeth growing from persistent pulps. Hallux not opposable. Superior true molars tritubercular or more simple.

The only character which distinguishes the suborder from the Insectivora is the possession of tritubercular or more simple molars above. This is, as I have shown,[2] a feature of more importance than has been hitherto supposed. The tritubercular molar is the primitive type from which the quadritubercular has been directly derived. It has furnished the starting point for both the carnivorous and the herbivorous dentitions, since it was common to both the clawed and hoofed mammals of the Puerco, or lowest known epoch of the Eocene period.

So far as known, the Creodonta were all plantigrade, and had long tails, and were mostly five-toed. With the possible exception of *Protopsalis tigrinus*, they all had relatively larger heads and shorter legs than the majority of the Carnivora of the present period. This is true of all the recent Creodonta, none of which reach the dimensions of many of the fossil forms.

The contents of the suborder Creodonta display, in their modifications, the usual range of simplicity and complexity consistent with the type, and the families may be arranged in some sort of phylogenetic order, in accordance with this principle. Nevertheless a difficulty arises as to what are ancestral or primitive conditions, and what characters, if any, must be regarded as the result of degradation. As other parts of the skeleton are less frequently obtained, these considerations relate chiefly to the dentition.

In my paper on the Homologies and Origin of the types of Molar Teeth, etc.,[3] I pointed out that the cone was the simple form of tooth from which all others must have been derived. In the Mammalia this may have been modified in several ways simultaneously, but two methods present themselves as the most certain secondary primitive types. The first of these is that of the simple premolar, where the cone is compressed, and is sooner or later followed by a horizontal extension or heel. This type persists in

[1] For greater detail on this topic, see Proceedings Philadelphia Academy, 1883, p. 77.

[2] Proceedings American Philosophical Society, 1883, p. 324. Palæontological Bulletin, No. 37.

[3] Journal Academy Nat. Sciences Philada., 1874, March.

the inferior true molars of the Mesonychidæ. The second modification consists in the addition of lateral cusps or spines to the simple cone. Such a type is seen in inferior molars of *Spalacotherium tricuspidens* Ow., of the Jurassic period, and in some of the incisors of *Plesiadapis tricuspidens*[1] Gerv. This form, by the shifting of the two subordinate cusps to the inner side of the principal one, will give a trituberculate molar of the lower series, an exaggeration of which is seen in the South African "mole,"

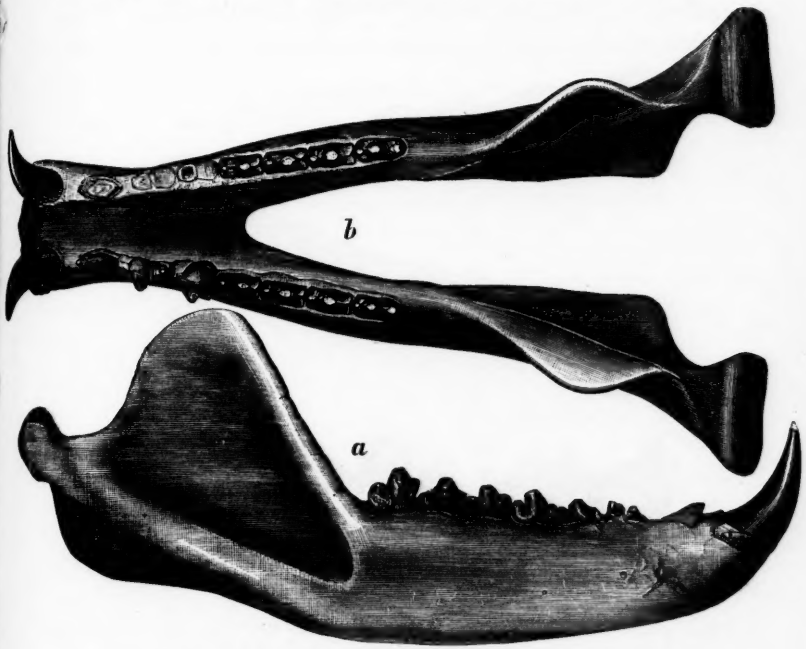


FIG 2.—Mandible of *Mesonyx ossifragus* Cope, from the Wasatch epoch of the Big Horn river, Wyoming, one-third nat. size. Original. From Report U. S. G. S. Terrs., Vol. III.

Chrysochloris. If a cingulum appears at the posterior base of such a tooth, we have a rudimental "heel," such as is seen in Centetes, and is still better developed in many creodont and marsupial genera, forming the basis of the inferior sectorial tooth of the Carnivora. This, which I have called the "tubercular-secto-

[1] Lemoine. Communication sur les Ossemens Fossiles d. env. Reims, p. 9, pl. II, fig. 13. The superior dentition of this specimen is represented in fig. 6.

rial," is especially well marked in Oxyæna (Fig. 3) and Stypolophus.

All stages of diminution of the anterior of the two inner cusps of the inferior molars may be seen in the genera of Centetidæ, as for instance in Ictops and Diacodon, until a true quadritubercular molar is reached as in Mioclænus. In Miacis and Didymictis one tubercular-sectorial remains with one or more tuberculars. The process of developing a tubercular inferior molar from a tritubercular tooth, is the reverse of what has taken place in the Carnivora, where the tubercular-sectorial has, by loss of parts,

FIG. 3.—*Oxyæna forcipata* Cope, mandible from the Wasatch bed of New Mexico, one-half natural size. Original from Report U. S. G. G. Survey W. of 100th mer. G. M. Wheeler, Vol. IV. The numbers indicate the approximate premolars and true molars.

become a true sectorial. With these explanatory remarks I present the following definition of the families. I have formerly used the shape of the astragalus as a family definition. In the majority of the Creodonta its trochlear face is not grooved. In the Mesonychidæ it is strongly grooved. In Mioclænus and some species of Stypolophus, as well as in the moles, it is slightly grooved:

I. Inferior molars premolariform.

Inferior molars consisting of a cone and heel.....*Mesonychidæ.*
Inferior molars with a blade formed of anterior and median cusps...*Hyænodontidæ*

II. Inferior molars tritubercular without heel.

No sectorial teeth; tibia and fibula coössified.....*Chrysochlorididæ.*

III. Inferior molars tritubercular-sectorial or quadritubercular.

a. No superior sectorial teeth.

Tibia and fibula distinct..... *Centetidæ.*

Tibia and fibula coössified; external tubercles of superior molars subconic, no clavicles.....*Mythomyidæ.*[1]

Tibia and fibula coössified; external tubercles two Vs; clavicles.....*Talpidæ.*

aa. First true superior molar sectorial.

Tibia and fibula distinct; no tubercular molars.....*Oxyænidæ.*

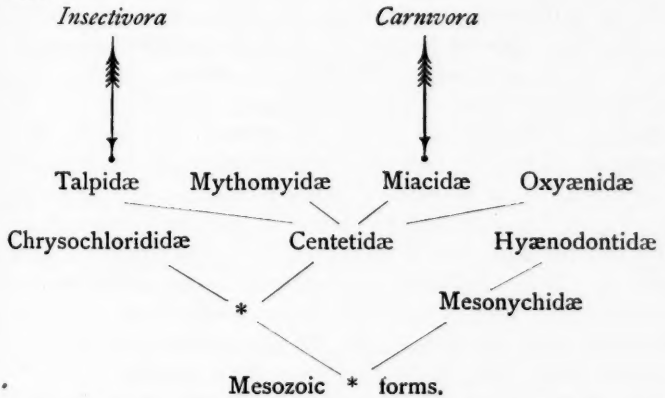
aaa. Fourth superior premolar sectorial.

Tibia and fibula distinct; true molars tubercular.....*Miacidæ.*

The number of genera and species embraced by these families is as follows. The extinct forms only are enumerated, and those of North America are specified:

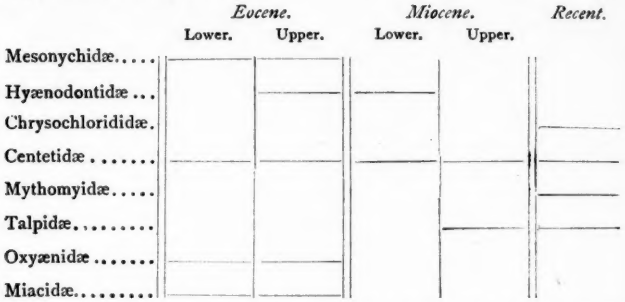
Families.	*Genera.*	*Species.*	*N. America.*
Mesonychidæ	4	7	7
Hyænodontidæ	1	10	3
Chrysochlorididæ	*	*	
Centetidæ	18	44	37
Mythomyidæ	*	*	
Talpidæ	*	*	
Oxyænidæ	3	7	4
Miacidæ	2	12	12
Totals	28	80	63

The affinities of these families may be expressed in the following diagram, which may be regarded as an attempted phylogeny also:



[1] This family is sometimes called the *Potamogalidæ*. Mythomys is, however, the name first published, with a description, for the typical and only genus.

In geological time the Mesonychidæ, Miacidæ and Oxyænidæ are confined to the Eocene period. The Hyænodontidæ extend through the Upper Eocene and Oligocene or Lowest Miocene formations. The Centetidæ are predominately Eocene, but in North America they are also found in the Oligocene. In recent times they are only known in the islands of Madagascar and Cuba. The Chrysochloridiidæ are modern and African, while the Talpidæ commence in the Middle Miocene in Europe, and are as abundant in recent times in the Northern hemisphere. Mythomyidæ are only known as recent in Africa. These relations may be expressed as follows:



The distribution of the genera with relation to the American formations will be considered later.

Mesonychidæ.

In this family the form of the inferior molars is not very different from that displayed by the last lower premolars of carnivorous Mammalia generally. The superior molars are of correspondingly simple structure, in like manner resembling the last premolars of the superior series of Carnivora and some other Mammalia. There are two types in the family. In the first, the astragalus is flat, as in most Creodonta (Fig. 5 *a b*). The only known genus is Amblyctonus, which I have, on account of its astragalus, placed in a separate family, the Amblyctonidæ. This course may be justified by future discovery. The inferior molars also differ from those of Mesonyx in the development of the anterior cusp, thus approaching the Hyænodontidæ (Fig. 4). The bones of *Amblyctonus sinosus* Cope, are about as robust as those of the coyote. They have so far been found only in the Wasatch beds of New Mexico. M. Fischer has described an allied mam-

mal from France under the name *Apterodon gaudryi*. He has not stated how this genus differs from Amblyctonus.

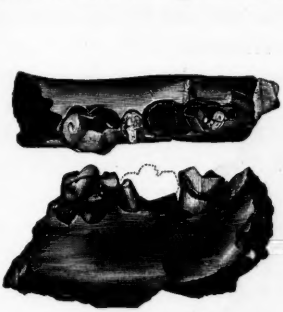


Fig. 4.

Fig. 5.

FIG. 4.—Part of mandibular ramus of *Ambyctonus sinosus* Cope, with the last three molars; upper figure the same, from above; two-thirds nat. size. From the Wasatch beds of New Mexico. FIG. 5.—Distal ends of tibia of, *a–b*, *Amblyctonus sinosus*, and *c d e*, *Oxyæna morsitans* Cope; *b* and *d*, distal views; two-thirds natural size. From the Wasatch beds of New Mexico. Original, from U. S. G. G. Expl. Surv. W. of 100th mer., G. M. Wheeler.

In the genus Mesonyx we have a structure of the astragalus found only elsewhere in flesh-eating mammals in the Hyænodon.[1] Its distal extremity has two well-marked facets, one for the navicular bone and one for the cuboid (Fig. 9). The appearance is that of a perissodactyle mammal, and the astragalus of the Mesonyx might well be taken for that of an ungulate of that suborder. The tibial face of the bone is grooved, another point in which it differs from most of the Creodonta. Still another characteristic peculiarity is seen in the forms of the ungues. These are neither claws nor hoofs, but between the two, resembling the corresponding part in some Rodentia. Their deeply fissured extremities show that they are rather allied to claws than to hoofs (Fig. 10). The narrow navicular facet of the astragalus renders it probable that the inner digit or hallux is wanting, and that there are but four toes in the hinder foot. The form of the trapezium shows that there are but four toes on the anterior foot (Fig. 7). One more character completes the singular ensemble presented by this genus. The zygapophyses of the lumbar vertebræ embrace each other as in the lower perissodactyles and artiodactyles, a character not found in the Carnivora or Insectivora.

[1] Fide Professor W. B. Scott.

Among the Creodonta I have only observed it elsewhere in the genus Mioclænus,[1] but the vertebræ of many of these animals are unknown. It is wanting in Thylacinus and the opossum, and rudimental in Sarcophilus, among marsupials.

Three species of the genus Mesonyx are known, *M. ossifragus*

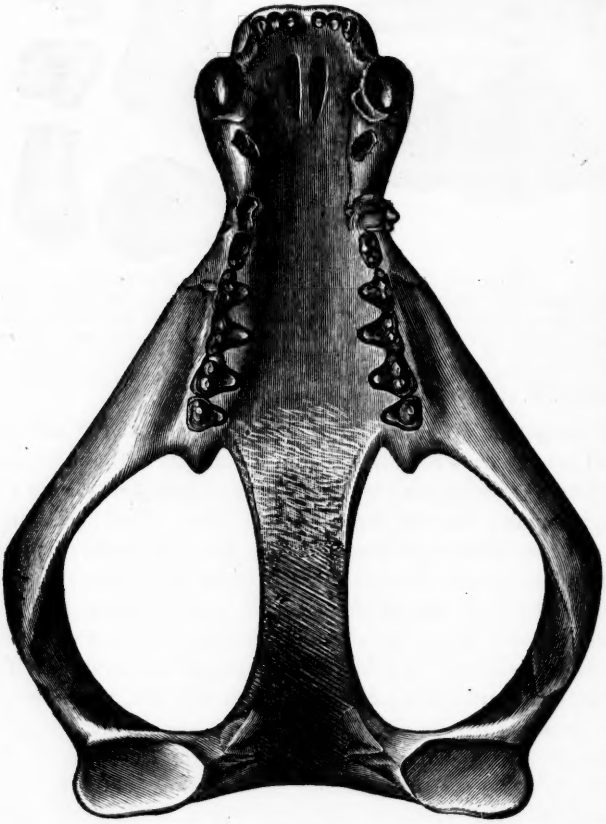


FIG. 6.—*Mesonyx ossifragus* Cope, skull anterior to postglenoid processes, inclusive, from below; one-third natural size. From the Wasatch beds of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., III, F. V. Hayden.

Cope, from the Wasatch Eocene, and *M. lanius* and *M. obtusidens* Cope, from the Bridger. The last named is the type. It is about the size of the wolf, and had more slender feet and claws than

[1] Proceedings American Philos. Society, 1883, p. 543.

the other two. The *M. lanius* was considerably larger than the *M. obtusidens*, equaling the black bear (*Ursus americanus*) in size. It had a large head, with a long, rather narrow and truncate muzzle. The limbs were relatively smaller, not exceeding those of the black bear in length and thickness. The tail was long and slender as in the cats, while the claws were broad and flat as in the beaver.

FIG. 7.—*Mesonyx lanius*, left anterior foot, one-half natural size. Upper figure first row of carpal bones of right side of same individual, proximal view. Original. From the Bridger beds of Wyoming.

The molar, canine and incisor teeth of my specimen, as well as those of one in the Princeton Museum, are much worn by use. This is especially true of the canines of both, while the crowns of the molars of my Bitter Creek specimen are almost entirely worn away. The same peculiarity is to be observed in the specimens of the allied *Amblyctonus sinosus*, which I obtained in New Mexico. It is probable that these species chewed hard substances. The peculiar approach of the lower canines is a special modification for peculiar habits, which I suspect to have been the devouring of the turtles which so abounded on land and in the waters of the same period. The slender symphysis could most readily be introduced into the shell, while the lateral pressure of the upper canines with the lower, would be well adapted for breaking the bony covering of those reptiles. The breaking of these shells in the attempt to masticate their contents would produce the unusual wear of the teeth observed.

The *Mesonyx ossifragus* is the largest species, its skull exceeding that of the grizzly bear in dimensions (Figs. 2, 6, 8, 9 and 10). It was originally found by the writer in the Wasatch beds of New Mexico, and was afterwards found by Mr. Wortman to be not uncommon in the corresponding formation in Northern Wyoming. From material obtained by this gentleman, we can form a general idea of the form and proportions of the *Mesonyx ossifragus*. We can depict an animal as large as a large-sized American black bear, with a long, stout tail and a wide head as large as that of a grizzly bear. The fore limbs are so much shorter than the hind limbs

that the animal customarily sat on its haunches when on land. In walking, its high rump and low withers would give it somewhat the figure of a huge rabbit. Its neck was about as long as that of an average dog. Its tread was plantigrade, and its claws like those of various rodents, intermediate between hoofs and claws. The animal, to judge from its otter-like humerus, was a good swimmer, although there is nothing specially adapted for aquatic

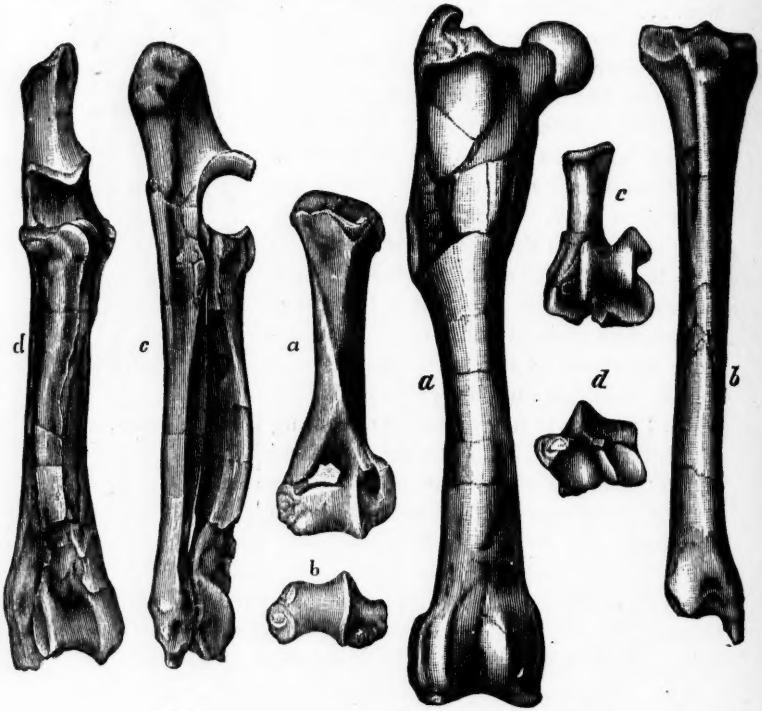


Fig. 8. Fig. 9.

FIG. 8.—Anterior limb bones of the specimen of *Mesonyx ossifragus* represented in Figs. 2 and 6, one-third natural size. Fig. *a*, humerus from front; *b*, distal view of distal extremity; *c*, right ulna and radius, external view; *d*, the same from above. FIG. 9.—Posterior limb of *Mesonyx ossifragus*, the individual represented in Figs. 2, 6 and 8, one-third nat. size. Fig. *a*, femur from front; *b*, tibia from front; *c*, astragalus and calcaneum from above; *d*, the same, distal view. From the Big Horn region of the Wasatch epoch.

life in the other bones of its limbs. Its teeth, on the other hand, are of the simple construction of the mammals which have a diet largely composed of fishes. We cannot but consider this animal

as one of the most singular which the Eocene period possessed. In size it was not exceeded by any other flesh-eater of the period, but was equaled by the *Protopsalis tigrinus*. Its anterior limbs were evidently relatively shorter than in the *Mesonyx lanius*.

FIG. 10. — Parts of digits of *Mesonyx ossifragus*, one-half natural size. Fig. *a*, metacarpal; *b*, metapodial, distal end; *c*, phalange; *d e f*, an ungual phalange from above, below and side. Original. From the Wasatch beds of Wyoming.

The *Sarcothraustes antiquus* is a large animal from the Puerco epoch of New Mexico, of about the size of the *Mesonyx ossifragus*. Its inferior molars have a wide heel as in Amblyctonus. The genus Dissacus Cope, occurs in the same formation and locality. Its inferior molars (Fig. 11) present an accessory cusp on the inner side of the principal cone. This constitutes the first step towards the tubercular-sectorial tooth of other families. There are two species, the *D. navajovius*, as large as the red fox, and *D. carnifex* Cope, of larger size.

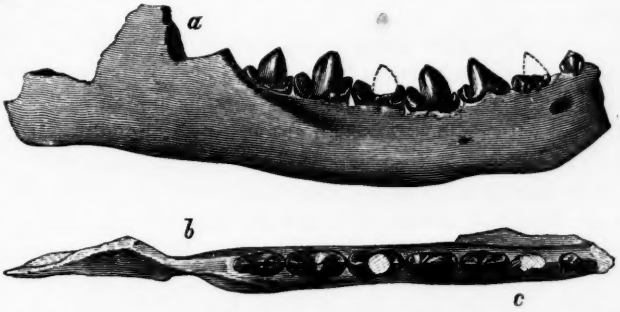


FIG. 11.—*Dissacus navajovius* Cope, right mandibular ramus, three-fourths natural size; *a*, external; *b*, superior views. From the Puerco beds of New Mexico. Original.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— That the ordinary jury is incompetent to deal with nice questions of mental status which come before our courts receives frequent proof. And this will always be the case so long as the question of "responsibility" is permitted to complicate the question. Two recent verdicts bring this subject before us at the

present time. Nutt, of Uniontown, Pennsylvania, was declared insane by a jury who knew him to be sane, in order to avoid the necessity of hanging him for a murder which they thought justifiable. Meredith, of Philadelphia, is declared sane, although his nearest relatives testified to his monomania, and his written defence proved that their statements were correct. This was done to avoid the necessity of depriving the subject of the investigation of his liberty.

It is thus clear that our laws on this subject need revision. They should keep in view the fact that the brain is liable to temporary disorders like other organs, and that persons must not be adjudged "insane" because they have displayed insanity on one or more occasions in their history. Second, the question of "responsibility" should be subordinated to more easily understood aspects of the question. Thirdly, undoubted insanity should not be considered ground for restraining liberty in some cases, nor for escape from penalties in others. In explanation of these points we reproduce here our remarks in the NATURALIST for January, 1882, apropos of the assassination of President Garfield:

"In the first place the present definition, which only admits insanity where the criminal is unable to judge of the consequences of an act, is certainly erroneous. Persons undoubtedly insane often act with deliberate design and great forethought. It would be a safe, though not a perfect definition of insanity, to describe it as a state of mind in which acts are committed which are in direct opposition to the plain and obvious interests, not of persons affected by the act, but of *the actor*. Here the question of the ignorance of consequences is restricted to its legitimate field, the instinct of self-preservation, through which the rational faculty has originated. It is another way of stating that the emotional or sentimental elements of character have so far overcome the rational as to cause the commission of self-destructive acts. Under this definition an act of violence committed in savage society would not indicate insanity, while the same act committed in civilized society, where means of detection and punishment abound, would be properly regarded as that of an insane person.

"In such a classification, criminals are those who disregard the rights of persons and property with a *reasonable* expectation of advancing their own interests thereby.

* * * * * * * *

"The punishment of the insane should be like that of the sane criminal, designed to protect society in two ways; firstly, by restraining the criminal himself from inflicting further injury; and secondly, by furnishing persons in the community of similar mental constitution with reasons for believing that it is contrary to their interests to commit like acts. In this way the law would furnish such insane with motives which would produce a change in the balance of the mind, the result being sanity. The punishment of death is as proper in such cases as in that of sane criminals of corresponding grade. The death penalty might even be necessary in the case of that lower grade of the insane who do not understand consequences. In this case the only object sought is the protection of the community, for motives are less operative with these than with the higher class of the insane. In either, the question of moral responsibility is omitted from consideration, as being beyond the range of human knowledge."—*C.*

—— When philology and archæology together take up the same tools and work at the Aryan problem, employing the critical methods of palæontology, the results are most promising. Several works recently published converge upon the question as to the origin, or rather the birthplace of our Aryan ancestors. The origin of our domestic animals, particularly the horse, ox, sheep and pig, formerly supposed mostly to have been in Central Asia, is now shown to have been in Central and Eastern Europe as well as Western and Central Asia. The birthplace of the cereals appears to have been for the most part in Western Asia and in Europe. Any one who will, from the facts given by DeCandolle in his "L'Origine des Plantes cultivées," plot upon a map the areas where they have been found wild, will be surprised to see that most of the areas of wheat, barley, rye and oats lie in the western border of Asia and in Southeastern Europe. We are not, then, compelled to vaguely look to the highlands of northwestern India and of Central Asia for the origin of our domestic animals and plants.

And now a reviewer in the *Academy* of Dec. 8, Mr. A. H. Sayce, in noticing two recent German works on the origin of the Aryans, quotes Penka (Origines Ariaceæ), as insisting upon "the uncontrovertible, but hitherto neglected, doctrine that language alone will not interpret for us the former history of our race. Without the aid of anthropology it is not only useless but misleading." If Professor Penka depends too implicitly on the testimony of skulls, Mr. Sayce declares that Professor O. Schrader (Sprachvergleichung und Urgeschichte) has for the first time employed a thoroughly critical method in determining the character and condition of primitive Aryan society; with results "very different indeed from the idyllic picture of that civilized commu-

nity to which Pictet and other writers have accustomed us. The early Aryan comes before us as a coarse and uncivilized nomad, unacquainted with the use of metals, and protecting himself with the skins of wild beasts from the inclemencies of the climate." This Aryan society was like that of the Swiss pile-dwellers, whom, indeed, Professor Schrader believes to have been Aryan, drawing attention to the similarities between the results he has derived from his linguistic researches and the discoveries of archæologists in the ruins of the Swiss lake-dwellers of the stone age.

Professor Schrader's "linguistic palæontology," carried on, adds the reviewer, under the salutary control of archæology, leads him to the same conclusions, though by a different road, as Professor Penka, *i. e.*, that Europe, not Asia, was the original home of the Aryan family, as first suggested by Dr. Latham. Mr. Sayce tells us that this theory has recently been gaining ground, remarking: "We now know that it is to the European, rather than to the Indic languages that we must look for the truest representation of primitive Indo-European grammar and phonology. The argument, therefore, formerly used to support the claim of an Asiatic origin for the Indo-European family of speech must now be turned against it."

Penka considers the starting point of Aryan emigration to have been Scandinavia, the Aryan invaders of Northwestern India having been a later and distant offshoot of the primitive stock. Mr. Sayce has been attracted by Poesche's hypothesis, "which makes the Rokytno marshes the original center of the Aryans." However that may be, the evidence is now tending to show that the districts in the neighborhood of the Baltic were those from which the Aryan languages first radiated, and where the race or races who first spoke them originally dwelt.

Thus philology, anthropology, zoölogy and botany now unite in suggesting that the birthplace of the Aryans was in Eastern Europe and the western borders of Asia, rather than the Himalayan plateau. Our Aryan savage ancestors were probably herdsmen and shepherds as well as forest rangers, living partly on the treeless plains of Russia in Europe, and partly in the forest-clad lowlands of Scandinavia and Northeastern Germany.

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RECENT LITERATURE.

MEINERT'S ANATOMY OF THE CENTIPEDE'S HEAD.[1]—This memoir is fortunately written in English. It treats in detail of the external anatomy of the parts of the head in Scolopendra (*S. subspinipes* Kohlr.) as most typical of the Chilopods. As a contribution to the morphology of the myriopods it will always be

[1] *Caput Scolopendræ. The Head of the Scolopendra and its Muscular System.* By FR. MEINERT. With 3 plates. Copenhagen, 1883. 4to, pp. 77.

valuable, though we doubt if some of the author's views will command general assent. The details appear to have been worked out with care, while the drawings seem to have been very carefully made by the author, and beautifully engraved by Lövendal.

In the course of his lengthy views of the works of his predecessors, the author criticises and disproves Newport views that the head of chilopods is composed of eight sub-segments. Four pages of the memoir are devoted to an elaborate and useful tabular view of the opinions of forty-six authors as to the morphology and nomenclature of the mouth-parts.

Dr. Meinert gives a new explanation and nomenclature of the mouth-parts. He also claims that they are homologous with those of biting insects, or, to use his own words, set forth in an idiom peculiarly his own, "it is purposed to serve me to show the coincidence of the head of Chilopoda and its parts of the mouth with the head of the Insect and its parts of the mouth, especially in the Orthoptera, that is to say, in insects with free biting parts of the mouth, and four pairs of these parts or four metamers in the head." Here it may be remarked that Meinert does not regard the antennæ and the antennal segment as homologues of the other mouth-parts and segments. In his own words, "The real head then must be said to consist of the three foremost metamers, together with their exponents or limbs; that is to say, the labium, the maxillæ and the mandibles, and besides of the lamina cephalica, which latter, as well as its appendages, the antennæ, I by no means can consider to be homonomeous with the other metamers of the body and of the head, and with their exponents." Meinert's reasons for rejecting the view that the so-called antennal segment is not such, are weak and unsatisfactory; its form is necessarily unlike the other segments, as it constitutes a preoral segment and the front of the head; it is therefore unlike the succeeding segments, though homologous with them. He considers the antennæ as dorsal rather than "ventral (or pleural);" here we think Meinert wrong. Our author does not accept Metschnikoff's views as to the embryology of Chilopods, although the Russian's observations show plainly enough that the antennæ should be regarded as homologues of the other mouth-parts, and Sograff's splendid memoir (published, however, since Meinert's present paper) appears to confirm Metschnikoff's views. Meinert claims that "neither in the Chilopoda nor in the insects can any ventral part be pointed out in the lamina cephalica;" and he also insists that the alimentary canal does not pass through the antennal segment, or, as he calls it, *lamina cephalica.* But if any one will examine Sograff's Figs. 38, 39 and 43, we think that he will admit that Sograff fully proves that, as in insects, the alimentary canal at first opens as a mouth in the middle of the antennal segment, moving back into the mandibular segment in after life, while the antennæ arise as pleural outgrowths in almost exactly

the same manner and relative proportion as the mandibles and maxillæ. Here, as in other memoirs, Meinert lacks breadth and comprehensiveness in his treatment of arthropod morphology. We also think that there is a decided lack of homology between the mouth-parts of myriopods and hexapods, as we have endeavored recently to show, the terms labium, maxillæ and mandibles not being properly applicable to the myriopods, however alike their appendages are in the embryo to those of Hexapoda.

LEYDIG'S RESEARCHES IN ANATOMY AND HISTOLOGY.—Professor Leydig devotes the greater part of his most recent work, "Unbersuchungen zur Anatomie und Histologie der Thiere" (Bonn, 1883, pp. 174), to the discussion of the intimate structure of the tissue cells of the Insecta. A few pages treat of the tactile papillæ of the Kentucky blind fish (*Amblyopsis spelæus*), and of the olfactory cones in the cray-fish from the Mammoth cave (*Orconectes pellucidus*). As these forms have been described in detail in earlier volumes of this journal (Jan., '72, Dec., '71), some of the readers of the NATURALIST may be interested in the result of the distinguished histologist's observations.

The tactile papillæ are arranged on the top of the head on ridges, which thus acquire a pectinated appearance (see this Jour., 1871, Pl., Figs. 7, 8, 9, 10). Professor Wyman described a filament projecting out of the funnel-shaped extremity of each papilla, but Leydig denies the existence of the filament, considers that the funnel is occupied in the fresh state by a beaker-shaped sense-organ similar to those met with everywhere in the skin of Teleostei, and suggests that as the thin edge of the funnel is occasionally prolonged into several points, one of these was mistaken for a central filament by Wyman.

In addition to the larger papillæ, isolated smaller ones are scattered over the head and mucous membrane of the mouth, being most frequent on the lips. They are not visible to the naked eye, and in fact generally require the microscope for their demonstration. They are slender and cylindrical, with a slightly broader base and fringed extremity, also hollowed out for the lodgment of a "sense-beaker."

As the want of sight in the blind fish is compensated for by the development of the tactile ridges, so in various Crustacea of the "cave-fauna" it has been noticed that the olfactory cones are present to a much greater number than in allied forms possessed of sight. Professor Leydig was unable to compare *Orconectes pellucidus* in this respect with any of the other North American species, but finds that the external branch of the antennula which bears the olfactory cones has thirty-six segments. The cones are chiefly confined to the middle third of the flagellum, and are there arranged to the number of seven on each segment, three being on the middle and four in a bunch on

the distal end. The number to each segment decreases both towards the proximal and distal ends of the cone-bearing region.

On examination of the only species of which I have living specimens just now, *C. propinquus*, I find the external branch of the antennula composed of eighteen or nineteen segments. The distal nine of these alone bear olfactory cones, and only five of them (the 11th, 12th, 13th, 14th, 15th), have the full number of eight on each joint, so that *O. pellucidus* would appear to form no exception to the rule which has been noted above as to the European "Cave" Crustacea.—*R. R. W.*

STERNBERG'S PHOTOMICROGRAPHS AND HOW TO MAKE THEM.[1]—Many a naturalist who may be unskilled in drawing, or who may desire to reproduce by photography histological preparations, will be thankful for this excellent work, which so describes the technique of photomicrography as to enable one familiar with the use of the microscope to make photomicrographs with the least expenditure of time and money. The author, who is well known for his researches on disease-germs, has designed the work for beginners, who, like the author, had resorted to photography for the purpose of making pictorial memoranda of his microscopical observations.

The first part of the book is devoted to technology, and considers light, microscopical apparatus, the camera and photographic material, the arrangement of microscope and camera for photography, the operating room and fixtures, etc., the exposure and development of the plate, the fixing, intensification and preservation of the negative, as well as photographing by reflected light, and making positives upon glass. This part concludes with chapters upon the selection and preparation of objects for photographing.

The second part is devoted to a description of plates, and to a popular account of elementary histology, containing accounts of the Amœba, of Micrococci, of one-celled algæ, of epithelial and other cells, blood-discs and of vegetable cells and diatoms, the microphotographs being excellent. The book is a timely and useful one, and though the plates are very useful as examples of excellent work, we are not sure that it would not have given more unity to the book to have issued the second part as a separate work. At any rate there will doubtless be a good demand for such a hand-book as the present one. It is well printed and illustrated.

MISS BUCKLEY'S LIFE AND HER CHILDREN.[2]—The title of this

[1] *Photomicrographs and how to make them.* Illustrated by forty-seven Photographs of Microscopic objects, reproduced by the Heliotype process. By GEORGE M. STERNBERG, M.D., U.S.A., etc. Boston, J. R. Osgood & Co., 1883. 8vo, pp. 204.

[2] *Life and Her Children.* Glimpses of Animal Life from the Amœba to the Insects. By ARABELLA B. BUCKLEY. 100 cuts. New York, D. Appleton & Co., 1883. 12mo, pp. 312, $1.50.

little book is designed to express, as the preface states, "the family bond uniting all living things, as we use the term, 'Nature and her works,' to embrace all organic and inorganic phenomena." Although British animals are referred to wherever possible, yet the book will be found to be most agreeable reading by our young naturalists, boys and girls. We have never met with a book better calculated to interest the young, while it is written from a high standpoint. After the youthful reader has read this, and "Winners in Life's Race," by the same author, he will be prepared to understand the evolutional questions which will come up in after reading and study. As it is, the transition from old-fashioned books about animals to the more advanced ones, prepared from an evolutional standpoint, is so sudden that the reader is sometimes thrown off his balance. The tone of the author of "Life and her Children," while liberal, is also reverential.

The illustrations of the marine animals have been prepared by Dr. Wild, artist of the *Challenger* expedition; they are sketchy and attractive, though not always well engraved; but they are valuable to the young reader from showing the creatures' surroundings of water, rock and ocean bottom. The drawings of the insects are indifferent, as are the lithographic plates. The book will be excellent reading in connection with school work.

HANSEN'S STRUCTURE OF THE MOUTH PARTS OF DIPTERA.[1]—The author adds another to the series of works now appearing on the structure of the mouth parts of the Diptera, which is one of the most difficult subjects in insect anatomy, and one requiring both close observation and good powers of generalization, particularly in comparing these highly modified parts with those of other insects.

The descriptive part of the work is preceded by a full historical account of the work of others, from Swammerdam to the recent writers, such as Dimmock, Becher, Meinert and Kraepelin. As the essay is written in Danish, we can only say that it bears the appearance of having been prepared with great care and thoroughness. Fortunately there is a Latin abstract or "Conspectus systematicus," of the chief results, which will make the treatise vastly more useful to the English student. Besides this, the explanations of the plates are both in Danish and Latin. The figures have been beautifully drawn by the author, and exquisitely engraved on copper by Lövendal, the prince of living zoölogical engravers. The sketches are characterized by clearness and delicacy. We only wish that they could have been drawn on a larger scale. So far as we are aware this is the most important entomotomical essay of the year.

[1] *Fabrica Oris Dipterorum: Dipterernes Mund i Anatomisk og Systematisk henseende.* Ved H. J. HANSEN. Cand. Mag. IIte afdeling. (Tabanidæ, Bombyliidæ, Asilidæ, Thereva, Mydas, Apiocera.) Med 5 Kobbertavler. Kjöbenhavn. 8vo, pp. 220.

WHERE DID LIFE BEGIN?[1]—This brochure is devoted to the demonstration of the proposition that life made its appearance on the earth at the poles. The obvious reason for this conclusion is the fact that it was at the poles that the temperature of the earth first reached a point sufficiently low to permit life as it appears to us now. The question is discussed from both the physical and biological standpoints, and the facts of geographical distribution are brought to bear. The reasoning is good and fairly deducible from the premises. The law, while true in general, is nevertheless subordinated in its workings to questions of the distribution of land and water. We cannot, therefore, agree with Mr. Scribner in the supposition that hairy elephants and rhinoceroses have always dwelt in arctic climes, and had not migrated from tropical regions in earlier ages. The land of the arctics which belongs to the possible age of higher mammals is of later geologic age than that of the south, so that many of the terrestrial types of animals and plants have of necessity originated in southern regions.

GEOLOGICAL REPORT OF INDIANA FOR 1882[2]—This useful volume comprises the results of further surveys of different counties, besides containing an outline of the geology of the State, with an outline map. It likewise contains a catalogue of the flora of central-eastern Indiana by Dr. A. J. Phinney. A large proportion of the volume, with thirty-two plates, is devoted to the elucidation, by Professor James Hall, of the late Mr. Van Cleve's fossils, and manuscripts relating to them; also lengthy notes on the Spergen Hill carboniferous fossils, by Professor Hall. The report closes with a brief reference to the diatoms of the waters of Indiana accompanying six plates of figures.

MARTIN'S HUMAN BODY.[3]—This is an abridgement of the author's larger text-book on human physiology, and seems to us to be as well, if not much better adapted for general use than any other book on this subject. Teachers certainly will find it a fresh and original book, and will be aided in their work of teaching this difficult study by the appendices to many of the chapters, giving directions for the performance of simple physiological experiments. The illustrations are abundant and excellent, particularly the full-page illustrations in colors, which are well printed.

[1] *A brief inquiry as to the probable place of beginning and natural course of migration therefrom of the Flora and Fauna of the Earth.* By G. HILTON SCRIBNER. New York, Charles Scribner's Sons, 1883.

[2] *Indiana Department of Geology and Natural History.* (Twelfth Annual Report.) JOHN COLLETT, State Geologist, 1882. Indianapolis, 1883. 8vo, pp. 400.

[3] *American Science Series, Briefer Course.* The Human Body. An elementary text-book of Anatomy, Physiology and Hygiene. By H. NEWELL MARTIN. M. D., etc. New York, Henry Holt & Co., 1883. 12mo, pp. 355. $1.50.

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Newberry, J. S.—The origin of the carbonaceous matter in bituminous shales. Ext. Annals N. Y. Academy of Sciences, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—THE CONGO, FROM ITS MOUTH TO BOLOBO.—Mr. H. H. Johnstone (Proc. Roy. Geog. Soc., Dec., 1883) not only describes the lower course of the Congo, but gives a map and details respecting the aspect of the western coast of South Africa generally. The forest belt of Africa extends from Sierra Leone to the Ogowé, a little to the south of which it is succeeded by the park-like scenery so characteristic of South Africa. The thick forest is determined by the perpetual rains, and its absence in the country, which has a dry season of greater or less duration, is determined by the fires which, started by the natives among the long dry grass, sweep the forest from the hills. This well-timbered but open country is at first a narrow strip along the coast, but the boundary line soon bends to the east. The limit of the oil-palm (*Elais guineensis*) is approximately 10° S. lat., but along the coast it does not stretch far south of the Congo mouth. A little to the south of the Congo, between Ambrizete and Cabeca da Cobra, the park-like scenery begins to retreat from the coast, and is followed by a region of sparse vegetation, with euphorbias and aloes, and occasionally baobabs, mimosas, and figs, and where there is often less than two months rain in the year. Patches of this kind of country, broken by timber along the rivers, fringe the coast as far south as Benguela, where a belt commences and runs far into the interior. At about the 13th parallel this region of scanty vegetation gives way to absolute desert, which is a prolongation along the south-western coast of the Kalahari desert. The northward trend of the Congo brings its course above Stanley pool into the region of forest and perpetual rain.

The sandy wastes between Mossamedes and Orange river grow little but the strange Welwitschia and a few stunted Bauhinias, but the park-like country has the Hyphœne-palm, the oil-palm, the cottonwood, the baobab, figs, mimosas, numerous splendid papilionaceous trees, etc. This is also the country of the large game animals. The thick forest, where vegetable life rules supreme, shelters the anthropoid apes, which thus do not approach within 100 miles of the northern bank of the Lower

[1]This department is edited by W. N. LOCKINGTON, Philadelphia.

Congo, yet probably cross it near the equator. The gray parrot, often stated to have its southern limit at the Congo, reaches, perhaps, its greatest development in Malange, nearly 300 miles south of that river.

The single mouth of the Congo is unimposing beside the deltas of the other great African rivers, and it is not unlikely that this outlet is not of very ancient date. Many of the so-called creeks between Boma and the sea have gained in length within the memory of settlers on the Lower Congo, and seem to be attempts on the part of the river to force a new way to the sea. Banana point, a sandy peninsula at the Congo mouth, would long ago have been washed away had it not been for man's protection. The scenery of the region of the rapids, Yellala, Ngoma, and Isangila is graphically sketched by Mr. Johnstone, as also the Ntombo Mataka falls above Manyanga—the nearest approach to a cascade the river exhibits. Above Stanley pool the scenery is tropical, and the river moves swiftly between high wooded banks. Below Boma, the hottest place on the Congo, good water can be obtained from ever-running rills, so that above Vivi dysentery is almost unknown. At Msuata, above Stanley pool, the temperature ranges from 87° in the shade at noon to 60° at two in the morning.

The races between Lake Bungweolo and Stanley pool are Bantu of the purest type. On the coast the Bantu seems to have mixed with an earlier negro population. The Ba-yansi of Bolobé are perfect Greek statues in their forms, and have a civilization of their own, building houses of three or more rooms, covered with matting, and having a door of laths and matting that swings on a rude hinge. Their pottery, weaving, decoration, metal work in iron and copper, attempts at husbandry and contrivances for fishing and bird-catching show a great advance on the tribes of the lower river. They are very free from superstitions, and half apologize for the remains of fetish among them.

Most of the fruits and vegetables grown by the tribes on the Congo seem to have been introduced by the Portuguese.

There is no large kingdom in this region, but each village is a small independent state, and this fact has, in Mr. Johnstone's opinion, greatly facilitated the entry of civilization. If one village has declined to receive Mr. Stanley, the next has welcomed him out of rivalry, so that he is now looked up to as an umpire, and keeps the peace among the natives. The establishments of Vivi and Leopoldville are small towns; twenty-one stations have been founded in all, and an European can travel to Equator Station, 700 miles up the river, as safely as upon the Rhine.

The Kuilu.—At a recent meeting of the Royal Geographical Society, M. Van de Velde stated that in the spring of 1883 he had been sent by sea to the mouth of the Kuilu, while Captain

Elliot was sent by land from Isangila. The two met at Kitabi, and founded the stations of Massabe, on the coast, and Rudolfstadt, Baudouinville, Franktown, Stanley, Niadi, Stephanieville, and Philippeville further up the river. Many good native roads were found, and it is believed that a railway can be made from the coast to Leopoldville so as to avoid the rapids of the Congo.

M. Revoil's Journey in the South Somali Country.—This enterprising traveler has reached the town of Gananeh, on the Upper Juba. Notwithstanding the protection of the Sultan of Zanzibar and the good offices of the Governor of Magadoxo, and in spite of an escort of 200 men from the Somali tribe which holds the road, M. Revoil and his followers had a race for life to reach the town of Gualidi. This town is divided into six quarters, placed on both sides of the river Webbe, and is an extensive congeries of the conical huts called min, of which each Somal possesses two or three. By the end of August he reached Gananeh, and intends to go thence to the Galla country.

Geographical Notes.—Mr. Jas. Stewart, who has completed the survey of Lake Nyassa, and has been engaged in making a road between that lake and Tanganyika, died Aug. 30, 1883.——Sir John Kirk writes from Zanzibar that the rumors of the death of King Mtesa are not supported by anything known at Zanzibar.——Lieut.-Col. E. C. Ross believes that he has identified the Sitakus or Sitioganus of Nearchus and Pliny with the Kara-Aghatch, while the latter is the upper course of the Mund or Khor-i-Ziaret, the mouth of which, in the Persian gulf, is well known.——The Indian government contemplates sending an expedition to the Takht-i-Suliman, the highest peak of the Suliman range. The summit is a narrow plateau some five miles long from north to south, with a peak at each end over 11,000 feet high. It is believed that a day's observation from its summit will be the means of mapping some 50,000 square miles of the territory immediately beyond the north-west frontier of India.——Mr. Leys has visited the Padas, Lawas, and Limbang, three rivers opening into the Brunei bay, on the north-west coast of Borneo. The Limbang and Padas have comparatively large populations on their banks, while the smaller Lawas flows through a beautiful but sparsely-populated country.——The Lennard, a river of the Kimberley district, Northwest Australia, rises in the Leopold ranges, and at about thirty miles from the sea forms a delta, the northern arm of which is called the Meda, and the southern the May. The grass on these rivers was remarkably luxuriant. A large river (the Robinson) and several running streams, all lined with trees and densely grassed, were discovered by the Hon. J. Forrest. The country as a whole is thinly timbered, and the district is well adapted for raising cattle and horses.——The interior of

New Guinea has never been penetrated to any considerable distance, except along the course of rivers. Lieut. Armit only went twenty-five to thirty miles inland.——The death of M. de Brazza has been reported, but the report is now ascertained to be untrue. The *Revue de Geographie* states that harmony reigns between this explorer and the International Association.——M. de la Croix stated before the Geographical Society of Paris that he distinctly heard the detonations of the eruption of Krakatoa, though he was then at Lahat, 746 miles distant. M. Brau de St. Pol Lias informed the same society that Tolok-Betoung is now no more a seaport, since a barrier of pumice, nineteen miles in length, two-thirds of a mile in width, and from thirteen to sixteen feet deep, has, since the eruption, formed a floating jetty in front of the entrance of the harbor. The official number of the victims of the explosion is 15,000.——The Bolivian government has despatched an expedition against the Tobas (the murderers of Dr. Crevaux). M. Thouar accompanies it, and intends to survey the Pilcomayo river, and to verify the existence of its reported affluent, the Guayra.——M. Milne-Edwards has asserted before the Geographical Society of Paris that the bathymetrical map of the Atlantic ocean, published under German authority, is a work of fiction. In one place where the map marks 3000 fathoms, the *Talisman* expedition found 6000; and in another where the lead descended 3000 fathoms, the map showed 1000 only. The curves do not in any way correspond with the real relief of the Atlantic. The bottom of the Sargasso sea (3280 fathoms) is entirely volcanic, and thus the submarine fauna is poor. The soundings of this vessel will add greatly to our knowledge of the configuration of the Atlantic bed between Cape Verd and the Azores.——The Bay of Diego-Suarez, one of the finest harbors of the world, situated on the eastern coast of Madagascar, at a short distance from Cape d'Ambre, and so near the northern end of the island as to have easy communication with both the ocean and the Mozambique channel, belongs to the French, to whom it was ceded by Radama II.——Among the population of the southern portion of the western coast of Russia in Asia are some Chinese, most of whom are outlaws, but become cultivators of the soil when on Russian territory, and many Coreans.

GEOLOGY AND PALÆONTOLOGY.

THE HISTORY OF THE OREODONTIDÆ.—The following paragraphs, containing a synoptic view of the history of the Oreodontidæ, is taken from a paper recently read before a meeting of the American Philosophical Society:

From what is now known of the history of the Oreodontidæ, the following conclusions may be drawn. These are especially instructive as far as they go, since they involve the causes of the rise, great development, decadence and extinction of one

of the best marked types of Mammalia the world has seen. The history of this type involves more or less the history of the life of the North American continent during the Miocene epoch of Tertiary time. It moreover involves the laws which regulate the vital success of all types of life, and which express the causes of multiplication, of energy, of weakness and of sterility.

Two lines of the family, the Oreodontinæ and the Agriochœrinæ, come to light simultaneously in geological time, the White River epoch, or the Oligocene. The latter is a higher type than the former, in its more complex fourth premolars, while it is inferior in the non-closure of the orbits posteriorly. It may then be regarded as a parallel line. It has but two generic types, while the Oreodontinæ present us with seven. So far as yet known, the Agriochœrinæ did not continue as long as the Oreodontinæ, as will be shown in tabular form below.

In the progressive modifications of the Oreodontine series, the first step was the inflation of the otic bulla (genus Eucrotaphus). This was succeeded by the coössification of the premaxillary bone (genus Merycochœrus). These changes were accompanied by a regular increase in dimensions. The species of Merycochœrus are all of the largest size, and there are no small ones. The smallest species of Eucrotaphus are equal to the largest ones of Oreodon. The fourth genus, Merychyus, while it loses none of the points already gained, shows a deficiency in its facial walls, where vacuities appear. There is the greatest range of size here: with one species (*M. major*) as large as any of the Merycochœri, we have another as large as the usual Eucrotaphi (*M. zygomaticus*), and several one degree smaller, or as large as the largest Oreodons. In the next genus the facial vacuities have attained to an enormous size. The premolar teeth become smaller, and the weakness of the narrow symphysis of the lower jaw is made up for by its coössification. The size is reduced from equal to the smallest Merychyi to that of the smallest Oreodons (genus Leptauchenia). In the next stage (genus Cyclopidius) the superior incisors disappear. Finally, the lower jaw is so reduced in front that it loses both incisors and premolars, in spite of its symphyseal coössification (genus Pithecistes).

The species may be thus arranged in accordance with their distribution in time:

White River epoch.—Oreodon gracilis; O. affinis; O. culbertsoni. Eucrotaphus jacksoni; E. major. Agriochœrus antiquus; A. major; A. latifrons.

John Day epoch.—Eucrotaphus jacksoni; E. major. Merycochœrus superbus; M. leidyi; M. chelydra, sp. nov.; M. macrostegus, sp. nov. Agriochœrus guyotianus; A. trifrons, sp. nov.; A. ryderanus. Coloreodon macrocephalus.

North Fork of John Day River epoch.—Eucrotaphus trigono-

cephalus, sp. nov.; E. major. Coloreodon ferox; C. macrocephalus.

Ticholeptus beds.—Merycochœrus montanus, sp. nov.; M. rusticus, M. proprius. Merychyus arenarum, sp. nov.; M. pariogonus, sp. nov.; M. zygomaticus. Cyclopidius simus; C. emydinus, sp. nov. Leptauchenia major; L. decora; L. nitida. Pithecistes brevifacies; P. heterodon; P. decedens, sp. nov.

Loup Fork beds.—? Merychyus elegans; M. medius; ? M. major.[1]

The stratigraphic relations of these species may be represented under their generic heads in the following table:

—*E. D. Cope.*

Professor Owen on Fossil Mammals.—Professor R. Owen has recently described, from incisor teeth and their casts, *Sceparnodon ramsayi*, a mammal with rodent upper incisors, as in the wombat, but probably equal in size to a tapir. The microscopic characters of both enamel and dentine indicate its marsupial affinities. The remains are from the Pleistocene of Queensland. At the same meeting of the Royal Society (Nov. 15) Professor Owen described a humerus from the breccia cave in Wellington valley. Apparently this belonged to an Echidna of very large size.

At the next meeting Professor Owen described the skull of a Triassic mammal from South Africa (*Tritylodon longævus*). The teeth resemble those of Microlestes from the Keuper of Würtemberg and the Rhætic of Somerset, and those of Stereognathus from the Oölite. The fossil presents no characters to show definitely whether it was a placental or non-placental. It is evidently allied to the Meniscoëssus of the Laramie and Polymastodon of the Eocene.

Fritsch on the Permian Fauna of Bohemia.—Dr. Fritsch continues his work on the Vertebrata of the Permian gaskohle of Bohemia. The last number (pp. 159–182) contains descriptions of the following species and genera: Hylonomidæ, *Hyloplesion*

[1] The question refers to the geological age.

longicostatum; Seeleya pusilla; Ricnodon copei; R. dispersus; R. trachylepis; Orthocosta microscopica. Microbrachidæ, *Microbrachis pelekani; M. mollis; M. branchiophorus.* These species are fully described and admirably illustrated. In the Hylonomidæ Dr. Fritsch includes the genera Hylonomus Daws., Smilerpeton Daw., Hyloplesium Fr., Seeleya Fr., and Orthocosta Fr. In the Microbrachidæ he is inclined to include, besides Microbrachis, the American genera Tuditanus and Cocytinus Cope.

FILHOL ON EOCENE LEMUROIDS.—Dr. Henri Filhol has published in the *Annales des Sciences Geologiques* a valuable illustrated paper on the two lemuroid genera Necrolemur Filh., and Adapis Cuv. His object is firstly to show that these genera are distinct from certain American genera; and second, to describe the limb-bones and dental variations of the species of Adapis. As regards the first proposition it results from a statement by myself that the Necrolemur is identical with Anaptomorphus Cope, and the Notharctus Leidy, is identical with Adapis Cuv. Dr. Filhol shows that both these identifications are erroneous. The first correction I have already made in my forthcoming volume on the Tertiary Mammalia of the West, which has been in press about a year. I do not remember that I had published this conclusion prior to my Palæontological Bulletin No. 37, p. 318 (January 2, 1884), though it may be inferred from my language in the Proceedings American Philosophical Society, 1881, p. 154. It is also expressed in the January, 1884, number of the AMERICAN NATURALIST, Dec. 29, 1883. Necrolemur has three premolars and Anaptomorphus has but two. As Dr. Filhol remarks, he has made no detailed description of the teeth in his account of Necrolemur in the Recherches sur les Phosphorites de Quercy, hence the difficulty I experienced in determining at first its dental formula. The differences in the detailed structure of the molar teeth of the two genera, now pointed out by Dr. Filhol, are mostly due to differences of wear.

Dr. Filhol has obtained the canine and incisive series of Adapis, and can show that they are of generally identical structure. This discovery furnishes the needful desideratum for the distinction of that genus from Notharctus. Hitherto no characters sufficient to indicate a difference were known.

Dr. Filhol gives a figure of a nearly complete skull of *Adapis parisiensis.* His figures of the limb bones of the same species shows that they greatly resemble those of Tomitherium.—*E. D. Cope.*

THE MINERAL PRODUCTS OF THE UNITED STATES FOR 1882–3.—It is impossible to state the total mineral product in any form which shall not be open to just criticism. It is evident that the production statistics of such incongruous substances as iron ore, metallic gold and silver; the spot value of coal mined, and the

market value of metallic copper after having been transported hundreds of miles; the spot value of a crude substance like unground, unrefined barytes, and the value of a finished product like brick (in which the cost of manufacture is the leading item), such details cannot well be taken as items in a general summary. The statistics have been compiled with a view to giving information on those points which are of most interest and utility, and are presented in the form usual in the several branches of trade statistics. The result is that the values stated for the different products are necessarily taken at different stages of production or transportation, etc. Theoretically perfect statistics of mineral products would include first of all the actual net spot value of each substance in its crudest form, as taken from the earth; and yet for practical purposes such statistics would have little interest other than the fact that the items could be combined in a grand total in which each substance should be rated on a fairly even basis. The following groupings, therefore, are presented with a full realization of the incongruity of many of the items:

Values of the metallic products of the United States in 1882.

Pig iron, spot value	$106,336,429
Silver, coining value	46,800,000
Gold, coining value	32,500,000
Copper, value at New York city	16,038,091
Lead, value at New York city	12,624,550
Zinc, value at New York city	3,646,620
Quicksilver, value at San Francisco	1,487,537
Nickel, value at Philadelphia	309,777
Antimony, value at San Francisco	12,000
Platinum, value at New York city	1,000
Total	$219,756,004

Values of some of the non-metallic products of the United States in 1882 (all spot values except chrome iron ore).

Bituminous coal, brown coal, lignite and anthracite mined outside of Pennsylvania	$76,076,487
Pennsylvania anthracite	70,556,094
Crude petroleum	23,704,698
Lime	21,700,000
Building stone	21,000,000
Salt	4,320,140
Cement	3,672,750
Limestone for iron flux	2,310,000
Phosphate rock	1,147,830
New Jersey marls	540,000
Crude borax	338,903
Mica	250,000
Crude barytes	160,000
Chrome iron ore, value at Baltimore	100,000
Soapstone	90,000
Manganese ore	52,500
Asbestos	36,000
Graphite	34,000
Sulphur	21,000
Cobalt ore and matte	15,000
Precious stones, uncut	12,500

Asphaltum	$10,500
Corundum	6,250
Pumice-stone	1,750
Total	$226,156,402

Résumé of the values of the metallic and non-metallic mineral substances produced in the United States for 1882.

Metals	$219,756,004
Mineral substances named in the foregoing table	226,156,402
	$445,912,406
Fire-clay, kaolin, potters' clay, common brick clay, terra-cotta, limestone used as flux in copper and lead smelting, iron ore used as flux in lead smelting, pyrites (for acid making), zinc white made directly from ore, marls (other than New Jersey), apatite, gypsum, tin ore, bismuth, arsenic, iridosmine, mill-buhrstone and stone for making grindstones, lithographic stone, talc (other than "soapstone"), quartz, feldspar, fluorspar, terra-alba, chalk, crude mineral paints, nitrate of soda, carbonate of soda, sulphate of soda, native alum, ozocerite, mineral soap, strontia, etc.—certainly not less than	8,000,000
Grand total	$453.912,406

The grand total might be considerably reduced by substituting the value of the iron ore mined for that of the pig iron made; by deducting the discount on silver, and by considering lime, salt cement, borax, etc., as manufactures. It will also be remarked, that the spot values of copper, lead, zinc and chrome iron ore are much less than their respective values after transportation to market.

[Abstract from a report entitled "The Mineral Resources of the United States," by Albert Williams, Jr., chief of Division of Mining Statistics and Technology, United States Geological Survey, for the calendar year 1882 and the first six months of 1883.]

GEOLOGICAL NOTES.—*General.*—Among the volumes issued by the U. S. Geological Survey is a review of the non-marine fossil Mollusca, by C. A. White. The work is illustrated with thirty-two plates. Mr. White notices that five of the types that are recognized among the fauna of the Laramie group, Bathyomphalus, Cerithidea, Pyrgulifera, Melanopsis and Melania, have never been found among the living fauna of North America, but are represented by living species in the old world. The ten species of Unio described by Dr. Lea are referred to living species. Professor Hall believes that the two bivalves, *Cypricardites catskillensis* and *C. angustata*, described by Vanuxem from the Lower Devonian, truly belong to Anodonta. These excepted, the earliest Unionidæ known are two or three species collected by Professor Cope in the valley of Gallinas creek, New Mexico, from strata of Triassic, or perhaps Jurassic age.——M. Petiton (Bull. Soc. Geol. France, 1883) gives a sketch map of Lower Cochin China, showing the vast recent deposits of the Mekong delta,

extending over the whole of the peninsula that terminates at Pt. Camao. The interior of this peninsula, and large areas in the Me-kong, are completely marshy. Further north, on the Gulf of Siam, is a sandy tract traversed by granitoid mountains, and with a mass of sandstone in the center. In the north of the region is a porphyritic mass and one of sandstone. The chief mountain mass is to the west, in Baria and Bienhoa, and consists of four separate chains of granitoid rocks. A great part of Bienhoa, Longh-Thanh and Baria is covered with an extensive deposit of ferruginous clay, often containing so much iron as to become a veritable iron ore. This is often used as a building stone, and even at Saigon for macadam, a use for which its friable nature unfits it. M. Petiton states that in Cambodia, in many mountains to the north of Udong and to the west of the River Toule Sap, he has found microgranulite, granulite, porphyry and petrosiliceous porphyry. To the east of the river lies the mountain Pnom Neang Canh Rey, composed of the last named mineral, and iron mines and lime quarries also exist in the region. To the south-west of Pursat commences the enormous formation of more or less porphyritic sandstone, which extends thence westward into the Siamese province of Battambang. Very little stratification has been yet met with in Lower Cochin China, and the only fossil found was an encrinite in the limestone of Hatien.

Silurian.—Axel Tullberg contributes to the Zeitschrift der Deutschen geologischen Gesellschaft, a review of the Silurian beds of Scania, with a comparison with other similar formations. The Silurian beds of Scania are both palæontologically and petrographically very different from those of Northern Sweden. The Silurian of the islands Oeland and Gothland, East and West Gothland and Dalecarlia is, in great part, composed of limestone, with a rich fauna of trilobites, brachiopods, cephalopods, corals and crinoids; whilst in Scania the limestone is much reduced, and the great mass of the strata consists of graptolite-bearing schists. The thickness of the Upper Silurian is estimated at from 1480 to 1780 meters. This is distinguished into three stages, of which the middle one, the Cyrtographic shales, is about 350 meters thick, and the lower, or Rastrites shales, 120 meters thick. The upper stage of the Upper Silurian is in parts represented by about 1000 meters of Cardiola shales, the equivalent of the Ludlow shales of England; while four other groups which are locally developed correspond to the Dowton sandstone and Aimestry limestone of that country. The Lower Silurian beds are of gray limestones and shales. These strata have a thickness of 350 meters, while the Cambrian or "primordial Silurian" is only some 120 meters thick.——F. Nœtling (Zeit. Deut. Geol. Gesell., 1883) has a note upon the systematic position of the genus Porambonites, and describes two new forms, *P. schmidtii* and *P. baueri.* Both occasionally occur in boulders. Comparison of the charac-

ters of the valves and internal supports leads our authority to place Pentamerus and Porambonites in the same family Porambonitidæ. The genus Porambonites leads upwards towards the Strophomenidæ, while Pentamerus points towards the Rhynchonellidæ.

Devonian.—E. Kayser (Zeit. Deut. Geol. Gesell., 1883) describes two new goniatites and four new brachiopods from the Devonian of the Rhine.

Carboniferous.—In the *Geological Magazine*, Dec., 1883, Mr. H. Woodward continues his synopsis of the genera and species of carboniferous trilobites, characterizing four species of Brachymetopus, one of which is new. The same writer has also some notes on the nature of the two pits, or pores, placed one on each side of the glabella, in front of the compound eyes. He inclines somewhat to the belief that they may, as suggested by Mr. J. Young, be the marks of ocelli, such as occur in the Merostomata, both recent and fossil. If so, this would be further evidence of the affinities of both groups with the Arachnida. The pore is, however, present in the isopodous genera Sphæroma and Serolis, as well as in Limulus.

Permian.—H. Credner (Zeit. Deut. Geol. Gesell., 1883) contributes a fourth article upon the Stegocephali of the Rothliegenden near Dresden. *Branchiosaurus gracilis*, *Acanthostoma vorax*, *Melanerpeton spiniceps* and *Discosaurus permianus* are described. The last belongs to the family Limnerpetideæ.

Mesozoic.—Emil Haug (Neues Jahrb. für Min., Geol. und Pal.) reviews the so-called Chætetes of the Mesozoic strata. Of these he describes *Monticulipora recubariensis* from the Trias; *Chætetes beneckei*, a true Chætetes, from the gray limestone of the Lias of Southern Tyrol, and *Pseudochætetes polyporus*.

Tertiary.—The ninth volume of the Memoirs of the Swiss Palæontological Society contains a report upon the chelonians of the Vaudois molasse preserved in the Museum of Lausanne, by Dr. Portis. Three new species of Emys, one of Kinosternon, one of Cistudo, three of Trionyx are described, and a list of twenty-five species is given. In an appendix the same writer describes the new genus and species *Polysternon provinciale* from the Upper Cretaceous of Fuveau. The plastron of this species is peculiar from the presence of a pair of osseous plates between the hypoplastrons, which are very much shortened, and the xiphi-plastrons. These are styled by Portis prosteto-plastrons. The memoir is illustrated by twenty-nine plates.——Dr. Lemoine describes four species of Adapisorex, distinguished by the variable dimensions of the maxillaries and the well characterized form of the last premolar. These are *A. gaudryii*, *chevilionii*, *remensis* and *minimus*. All are of very small size and, as signified by the generic name, have affinities with the Tertiary Adapis on the one

hand, and on the other with the recent Soricidæ. All have been found in the Lower Eocene near Rheims.

Recent.—F. E. Geinitz (Zeit. Deut. Geol. Gesell.) states that the observations he has made during the last four years on the eastern part of the Mecklenburg coast prove that it is now sinking. ——F. Noetling (*loc. cit.*) gives a catalogue of the Diatomacea of the diluvium of Western Prussia, with particulars respecting the manner and quantity of their occurrence.——M. Virlet d'Aoust (Bull. Soc. Geol. France, 1883) contributes some valuable remarks upon the incessant formation of minerals, in various rocks, by means of molecular transport and displacement. A geode containing a small bell of the Gallo-Roman epoch is referred to, found probably in an ancient alluvial deposit at Conde'-sur Itón. M. d'Aoust states that he has proved that all flint geodes, buhr-stones, etc., are the result of molecular movements that have taken place since the formation of the rocks, and that limonites and the iron ores of alluvial beds have the same origin and are still in course of formation. He instances a geode found in a vine at Perigueux, a veritable eagle-stone,—hematite enclosing 200 silver pieces of coin of the fifteenth and sixteenth centuries. The re-formation of flint where buhr-stones have been taken out, is spoken of as a fact known to the quarrymen, as also that of grains of iron ore in alluvial clays.

BOTANY.[1]

THE AUGUST FLORA OF THE DISMAL SWAMP AND VICINITY.—The celebrated Dismal Swamp occupies the greater part of five counties, viz., Nasemond and Norfolk counties in Virginia, and Gates, Camden and Pasquotank counties in North Carolina, covering in all some 300 square miles of surface. A large portion of this vast area, being practically inaccessible, is still unexplored.

The swamp begins about ten miles south-west of Norfolk, and is best reached by taking passage on a small steamboat which plies between that place and Elizabeth City, N. C., *via* the Dismal Swamp canal. This canal passes within three miles of Drummond's lake, with which it is connected by a feeder. There are three or four places in the swamp where the boat makes regular stops, but there is no hotel, or even a decent cabin, within twelve miles of the lake.

The water in the canal is of a sinister blackness, very suggestive of malaria and chills, yet it is both healthful and palatable, and the swamp is the only locality on the southern coast entirely free from malaria. The water has the bitter flavor of tannic acid, derived from the juniper vegetation of the swamp.

A considerable population of whites and negroes subsist by the lumber trade, which is the great industry of this region, although

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

there are many good farms along the line of the canal. The soil is a bottomless peat bog which, when drained and sweetened with lime or oyster shells, produces fabulous crops of corn and tobacco.

The prevalent forest growth consists of *Taxodium distichum* (bald cypress), *Cupressus thyoides* (white cedar), *Juniperus virginiana* (red cedar), *Magnolia glauca* (sweet-bay), *Acer rubrum* (red or swamp maple), *Nyssa multiflora* (sour gum), *Liquidambar styraciflua* (sweet gum), and *Quercus aquatica?* (water oak).

The following herbaceous and arborescent plants were found in flower or fruit in the neighborhood of Drummond's lake during the second week in August: *Nesæa verticillata* (swamp loosestrife), *Saururus annuus* (lizard's tail), *Callicarpa americana* (French mulberry), *Jussiæa decurrens*, *Ludwigia alternifolia* (false loosestrife), *Rhexia virginica* (meadow-beauty), *Rosa carolina* (swamp rose), *Rubus occidentalis* (black raspberry), *Smilax rotundifolia* (green-brier), *Sabbatia paniculata* (American centaury), *Passiflora incarnata* (passion flower) and *Clethra alnifolia* (white alder). The latter in some places is so abundant that the air is as heavy laden with its perfume as "the zephyrs that wax faint o'er the gardens of Gull in their bloom." The white water lily (*Nymphæa odorata*) is very abundant in the canal, but the yellow water lily (*Nuphar advena*) is scarce, as is also *Pontederia cordata*, although the latter two are abundant in the Pasquotank river, into which the canal empties. The rush family is represented by two species of Juncus; the sedge family by the genera Hemicarpha, Scirpus, Rhynchospora and Carex; all of which are superabundant. The grass family is represented by the genera Aurundinaria, Cynodon, Glyceria, Poa, Paspalum, Briza, Uniola, Setaria and Leersia. I observed no specimens of Zizania, Andropogon, Erianthus nor Sorghum. The fern family is represented only by *Onoclea sensibilis* (sensitive fern), *Woodwardia virginica* (chain fern) and *Aspidium noveboracense* (shield fern).

The southern moss (*Tillandsia usneoides*) is abundant, usually growing on the bald cypress, but frequently on the gum trees. This moss, together with the canebrake (*Aurundinaria macrosperma*), give a decided sub-tropical aspect to the scenery.

Resuming our journey by boat from Drummond's lake, we are, in a short time, out of the canal and steaming down the Pasquotank river towards Elizabeth City, N. C. The latter place lies just beyond the southern extremity of the swamp. The land here is higher and dryer, and covered with a heavy growth of yellow pine, though there are many swampy places. In some of these swamps I found *Asclepias paupercula*, *Spiræa tomentosa* (steeple-bush), *Xyris caroliniana* (yellow-eyed grass), *Habenaria ciliaris* (yellow-fringed orchis), *Pardanthus chinensis* (blackberry lily), *Lilium superbum*, *Sagittaria pusilla* (arrow-head), *Polygala*

lutea (milkwort), *Nuphar advena* (yellow water lily) and *Pontederia cordata* (pickerel-weed).

In a damp, shady dell along the Pasquotank river, I discovered the rare *Hydrolea affinis*, *Lobelia cardinalis*, *L. syphilitica*, *L. spicata*, and a form of *Rhexia virginica*, with pure white petals, are abundant, and in such places is usually found a tangle of *Clematis viorna* (leather flower), *Centrosema virginianum* (butterfly-pea), *Apios tuberosa* (wild bean) and *Mikania scandens* (climbing hempweed). The river at this point is somewhat brackish, and along its margins *Spartina polystachya* (cord grass) grows sparingly.

The "pine openings" on the uplands are usually carpeted with *Sabbatia angularis* and Stylosanthes, Lespedeza, Desmodium, Crotalaria, Medicago and other Leguminosæ. On a barren heath, a short distance from the town, I found a thrifty colony of *Rosa bracteata*, which has not heretofore been found growing without cultivation north of Mobile, Ala.

In addition to the above, almost all the plants found in the Dismal Swamp are also found growing in this neighborhood, where they may be collected with much less trouble than in the swamp.

The flora of the swamp, it must be confessed, is rather tame and monotonous, but if it were possible to penetrate into the remoter fastnesses many new names would doubtless be added to systematic botany.—*Gerald McCarthy, Washington, D. C.*

Laboratory Notes.—1. *Development of Pollen.*—A most interesting and suggestive laboratory study consists in watching the development of pollen. I have found two plants especially valuable for such study, viz., Scotch pine and the common lilac. In the pine the student should commence work as soon as the clustered flowers begin to show themselves in early spring. Carefully made cross sections, made at intervals of a few days, show the gradual development first of the mass of mother-cells and later of the pollen itself. By care there is little difficulty in observing the prothallial cells in the young and thin-walled pollen cells.

The lilac is also easily studied, on account of its flower buds being so massed together as to permit the ready making of thin sections. In this case again the work must begin early, and should continue at intervals of a few days until the pollen is fully developed.

2. *The flow of Sap (water).*—A neat demonstration of the current explanation of the cause of the flow of water from trees in early spring may be made as follows: During a cold day cut a small branch from a maple tree, bring it into the laboratory and warm it quickly, when the water will flow freely; now cool it, when the flow instantly ceases; warm again, and the flow will be resumed, and so on.

Allen's Characeæ Americanæ Exsiccatæ.—We have, from time to time, noticed this important publication of specimen s o

these little-known plants. Fasciculus IV, just received, brings the number of species up to forty. As with the previous fasciculi, the specimens are excellent, and the labeling leaves nothing to be desired. The species are as follows: *Nitella tenuissima, N. glomerulifera, N. opaca, N. minuta, Tolypella comosa, T. fimbriata, T. intertexta, Chara hydropitys*, var. *genuina, C. sejuncta, C. gymnopus*, var. *armata*. A New Zealand species, *Nitella tricellularis* is also added.

The specimens were almost entirely collected in New York and New Jersey, indicating that they are, without doubt, to be found abundantly almost everywhere throughout the country, if collectors will but search carefully for them. These fasciculi are not sold, but may be obtained in exchange for specimens of Characeæ. One hundred specimens of any desirable form will be considered equivalent to a fasciculus in exchange. All correspondence and specimens should be addressed to Dr. T. F. Allen, 10 East 36th street, New York city. May we not ask the readers of the NATURALIST everywhere to keep a sharp lookout for the Characeæ?

BOTANICAL NOTES.—In the Proceedings of the Davenport Academy of Sciences, Vol. IV, Dr. C. C. Parry publishes a paper on the species of Arctostaphylos, natives of the Pacific coast of the United States. A new species (*A. oppositifolia*) is described from Lower California.——In another paper in the same volume, Dr. Parry describes four other new species from Southern and Lower California, viz., *Phacelia saffrutescens, Ptelea aptera, Polygala fishiæ, Gilia orcuttii*.——Dr. Gray's paper in the December *American Journal of Science*, on "Some points in Botanical Nomenclature," should receive a thoughtful reading by all our systematic botanists. It is to be hoped that DeCandolle's "Nouvelles Remarques sur la Nomenclature Botanique," of which Dr. Gray's paper is a review, will soon appear in English dress in this country. Uniformity of usage in matters pertaining to nomenclature is so desirable, that no one ought to consider himself fitted to describe and name a species until he has acquainted himself fully with the usages of naturalists. Every botanical library should contain the Dall Report on Nomenclature, published in the Proceedings of the American Association for the Advancement of Science, and the Laws of Botanical Nomenclature, by Alph. DeCandolle, of which an English translation by Dr. Weddell appeared in 1868.——The January *Botanical Gazette* contains a suggestive article, by Dr. Sturtevant, on the origin of domesticated vegetables. He proposes to study the origin of domesticated plants by taking into consideration their variations. He is led to infer long prehistoric culture of many American plants, as maize, pumpkin, tomato, potato, etc. Moreover, he considers it not improbable that many of our so-called natural species are but escapes from a prehistoric cultivation.——In the December *Torrey Bulletin* E. L. Greene

describes eight new species of flowering plants from S. W. United States; C. H. Peck notices a new genus (Neopeckia) established by Saccardo, while Dr. Vasey describes two new Western grasses. ——Lists of the plant catalogues of Indiana, Illinois, Michigan and Wisconsin are given in the same number by W. R. Gerard and N. L. Britten.——Henry and James Groves continue their notes on British Characeæ in the January *Journal of Botany*, recording and figuring *Chara braunii*, found in Britain for the first time last September.——J. G. Baker, in the same number, continues his synopsis of the genus Selaginella, bringing the number of species up to one hundred and nine.——Dr. Farlow's Notes on the cryptogamic flora of the White mountains in *Appalachia* (Jan., 1884) is an interesting contribution to our knowledge of the lower plants of this region. Six new species of fungi are described, viz., *Doassansia epilobii*, *Propolis circularis*, *Stictis tsugæ*, *Cercospora pyri*, *Ramularia oxalidis*.

ENTOMOLOGY.

Egg-laying Habits of the Egg-parasite of the Canker worm.—In our "Guide to the Study of Insects," (p. 200) we have briefly referred to a minute species of Platygaster which lays its eggs in those of the canker worm. We noticed on a pleasant day (Nov. 28, 1863, or a year or two earlier) two of these Platygasters upon two bunches of freshly laid eggs of the canker-worm moth, probably *Anisopteryx pometaria* Mann. We placed the eggs and ichneumons in a box, and returning to our room at the Museum of Comparative Zoölogy, watched the movements of the minute Platygasters with a lens of twenty-five diameters. One of them thrust its hind body down between the eggs, and while the rest of the body was still, and supported by the fore and hind legs, the wings resting on the top of the egg it was piercing, the antennæ were constantly vibrating. There could be seen a slight motion of the abdomen, the ovipositor meanwhile pushing and boring into the side of the egg. The operation of oviposition required from one to three, generally three, minutes. When the egg had been deposited in the right place, the Platygaster ran swiftly about, vibrating its antennæ more rapidly than before, until finding a suitable egg it suddenly paused, dropped its abdomen down between the eggs, and went through the same manœuvres as we have described. Sometimes it would suddenly take to its wings and fly off.

The other Platygaster kept on the under side of the loose bunch of eggs, where it found no good opportunity to oviposit. It was very uneasy, and would constantly run about from egg to egg. It would try for three or four minutes in vain to pierce the egg-shell, and we could see it thrust out its rather long, slender and sharp ovipositor, and apparently try to drill through the obdurate shell without success. It never attempted to pierce the

top or bottom of the egg, but directed its efforts to the thinner sides. It would frequently stop and clean its head with its fore legs, and the end of the abdomen with its hind legs, as a fly does. —*A. S. Packard, Jr.*

Paired Sexual Outlets in Insects.—J. A. Palmén records in the *Morphologische Jahrbuch*, 1883, the discovery in the May flies (Ephemeridæ) that the outlets of the sexual glands are paired, not only in the larvæ of all stages, but also in the imagines, and in both sexes, as had been earlier stated by Réaumer, Eaton and Joly. In the males the *vasa deferentia* pass through on the ventral side of the ninth segment two external appendages, both reproductive organs, at whose tips or sides the openings are situated. In the larvæ the female openings are not formed until after the last molt. In the females the two oviducts open on the ventral side of the hind body between the seventh and eighth segments.

Palmén suggests that the Ephemerids represent, in respect to the reproductive system among insects, a very primitive type of organization, and he concludes that the inner sexual organs of insects are built up of two different morphological elements, *i. e.*, (*a*) internal primitive paired structures (testes with *vasa deferentia*, ovaria with oviducts), and (*b*) integumental structures, such as the *ductus ejaculatorius* and vagina.

The Larch worm.—For three summers past the existence of the larch, hackmatack or tamarack, in the northern portions of New England, New York, and portions of New Brunswick and Canada, has been threatened by a saw-fly larva. This proves to be the *Nematus erichsonii*, as the transformations, habits and imago appear to be the same. From Ratzeburg's description, the habits of the American worm are evidently like those of the European species, and it is very probable that the insect is common to both Europe and Northeastern America. At any rate our species could not have been introduced with European larches, since its ravages have been committed in the wilder, less frequented portions of Maine, New Hampshire and New York, as well as on the seaboard in towns long settled. In brief, the habits of our species are as follows: The eggs are laid in the terminal young shoots of the larch from about the middle of June, in Massachusetts, to the early part of July in Northern Maine, the larvæ feeding on the leaves late in June and in July and early August. By the last of July to the first week in August, according to the latitude, the worms are nearly fully grown, while a few half-grown ones occur on the trees in Maine in the last week of August and the early days of September. It is very doubtful whether there are two broods. We will now give a more detailed account of its habits, from a report on the causes of the destruction of evergreen forests extracted from the forthcoming annual report of the Entomologist, Department of Agriculture, 1883.

The eggs had all hatched by June 23–28; few were to be found at Brunswick, although the incisions made by the female were commonly observed. The female saw-fly makes about a dozen incisions in the terminal young, fresh, green shoot, sometimes in one of the side shoots next to the terminal one; judging by the shape of the hole the eggs are of the shape described by Ratzeburg, *i. e.*, oval cylindrical and about 1.5^{mm} in length. The eggs are placed in two rows, alternating, not exactly parallel, one being placed a little in advance of the other. The eggs are inserted at the base of the fresh, soft, young, partly-developed leaves of the new shoot, which is usually by June 20–30 only

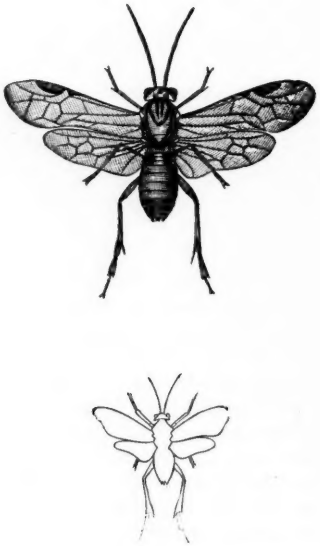

Fig. 1.

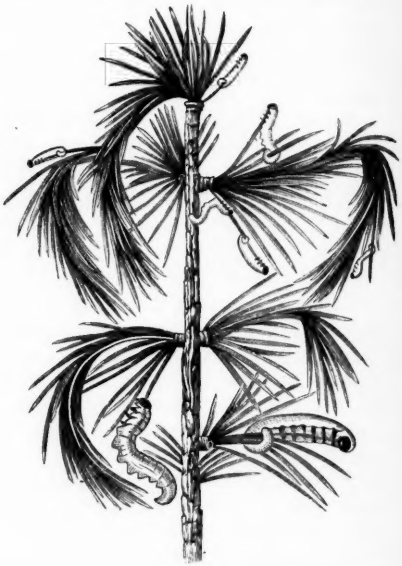

Fig. 2.

FIG. 1.—The larch saw-fly, nat. size and enlarged. Fig. 2.—The larch worm of different ages, nat. size. Miss L. Sullivan, del.

about an inch or an inch and a half in length. The presence of the eggs causes a deformation of the shoot, which curls over, the incisions being in all cases observed on one (the inner) side of the shoot. In many cases a last year's shoot was observed with the scars of the incisions on the concavity of the shoot. That the incisions were made by the saw-fly was proved by finding a freshly-hatched, but dead, larva in one of the holes. Sometimes one or two of the leaves die in consequence of the wounds made at their base.

After the foregoing lines were written we fortunately observed

a female in confinement, June 29, while engaged in the process of ovipositing; we should judge that the operation of sawing the slit and depositing the egg required not less than five minutes, and perhaps not much more than that length of time. The fly had been evidently at work for some time previous, as a number of eggs had been laid along the shoot; she had begun at the farther end and worked down to the base of the new, fresh, green shoot. She stood head downward while engaged in making the puncture, and was not disturbed by our removing the larch twig from the glass jar and holding it in our hand while watching the movements of the ovipositor under a Tolles triplet. The two sets of serrated blades of the ovipositor were thrust obliquely into the shoot by a sawing movement; the lower set of blades was most active, sliding in and out alternately, the general motion being like that of a hand-saw. After the incision is sufficiently deep, the egg evidently passes through the inner blades of the ovipositor, forced out of the oviduct by an evident expulsive movement of the muscles at the base of the ovipositor. The slit or opening of the incision after the egg has passed into it is quite narrow and about $1\frac{2^{mm}}{5}$ in length. While engaged in the process the antennæ are motionless, but immediately after the ovipositor is withdrawn they begin to vibrate actively, the insect being then in search of a site for a fresh incision.

After making the foregoing observations we found at Phillips, Me., July 1, and at Errol, N. H., July 4, numerous twigs containing eggs, and the flies were also observed upon the trees ovipositing. Although the slit is at first closed, as soon as the embryo increases in size the twigs swell where they have been incised by the ovipositor, and the slits enlarge or gape more or less, becoming much larger and more conspicuous than when the eggs are first deposited. It would thus appear that oviposition takes place about a week later in the vicinity of Brunswick, Me., than in Essex county, Massachusetts, and about a week later in Northern Maine and New Hampshire than on the coast at Brunswick.

When the larva hatches the incision gapes open, leaving an oval hole. Out of this gape the larva creeps, and it rarely eats the terminal shoot, but crawls upon the leaves of the whorls next to the terminal shoot. At first it nibbles one side of the needle or leaf, leaving it half eaten and rough, serrate, and partly withered along the edge. The half-eaten, withered leaves of unequal length in a whorl on the ends of the smaller branches enable one to detect the presence of the young worms on the tree.

Usually after the young larvæ have shed their first skin, they collect on the verticils of the larch and almost invariably begin to eat the needles, one after another, beginning at the distal end and eating the leaf obliquely until only a short stump is left; in this way one verticil after another is eaten, and when the worms are

half-grown they occasionally collect around the main stem of the twig in singular clumps or clusters, the hinder part of the body curled over their backs, and, owing to their oblique posture in reference to one another, appearing like a ball of worms. This singular appearance was briefly noticed by Ratzeburg. The castings or excrement are long, cylindrical, more or less truncated at each end. Our saw-fly differs slightly, as has been described, from the German in the eggs being laid at the base of the leaves on the newly-grown shoots, rather than on or just under the epidermis of the last year's shoots, where we have repeatedly and in vain searched for them. The larvæ were observed to hatch out from June 20 to 30 at Brunswick, Me.

The worms appear to attain their full size in about five to seven days after hatching; certainly less than or not more than ten days. There appear to be but three molts or changes of skin, *i. e.*, four stages of the larva. In casting the skin the head splits open along the median line of the vertex, and the epicranium or sides of the head split apart on each side, leaving the clypeus and labrum in place; then the body is drawn out of the rent, the skin adhering to the needle or leaf.—*A. S. Packard, Jr.*

The Hemlock Gelechia.—During the spring of 1883, the hemlock trees, large and small, in the vicinity of Providence, R. I., were observed to be much disfigured by the attacks of a small Tineid worm, causing sere and dead patches of leaves on the smaller branches and twigs of both large and small trees.

The small pale-green caterpillars bite off from six to eight leaves, constructing a broad, flat, irregular case; the leaves on being separated from the twig turning red or yellowish, thus forming a conspicuous patch. This rude case is held together with silk, the worm living in a rude silken tube, and feeding upon the inside of the leaves. The length of this tube, within which the little caterpillar finally changes to a chrysalis, is from 8 to 10^{mm} in length.

The worms are found from the first of May through the month of June. One changed to a pupa in its tube about the 20–25th of May, and the moth (in confinement) appeared June 1. Other chrysalids were found in the tubes from June 20 to 30, the moths making their appearance early in July. The larva, pupa, and moth are described in the report for 1883 of the Entomologist, U. S. Department of Agriculture.

The moth (*Gelechia abietisella*, n. sp.) is beautifully marked, and probably examples occur throughout the summer. Without doubt the eggs are laid on the twigs or leaves in the summer, and the caterpillars become almost full-fed before the winter, hibernating in their cases, becoming active in the spring. The worms are preyed upon by an ichneumon, the oval cocoon with one pupa which had recently transformed, and another ready to imaginate, occurring in the cases June 9th.—*A. S. Packard, Jr.*

FOOD-PLANTS OF THE ARMY WORM.—In Bulletin No. 3, Entomological Division, Dept. Agriculture, some new facts are recorded in reference to *Leucania unipuncta*, and notably an account of its injury to cranberry bogs. We quote the following in reference to its food-plants:

"The normal food-plants of the army worm are found among the grasses and grains, not a single species of either, so far as known, coming amiss. Wheat and oats seem to be its favorite among the small grains, though rye and barley are also taken with less relish. German millet, corn and sorghum, particularly when young and tender, are eaten by the worms. They were found, in 1881, feeding to a greater or less extent on flax in Illinois, although this is mentioned by Fitch as one of the crops which the worms will not touch. They have also been reported to eat onions, peas, beans and other vegetables, though probably only when pressed with hunger. As stated in our Eighth Missouri Report, upon the reliable authority of Mr. B. F. Mills, of Makanda, Ill., they have also been known to eat the leaves of fruit trees. Ordinarily clover is disregarded by the worms, though they occasionally nibble at it. A timothy field is often eaten to the ground, leaving the clover scattered through it standing. In this connection it may be well to state that on the Department grounds at Washington the newly-hatched worms have been found in a folded clover leaf, feeding thus protected, and under such circumstances as rendered it probable that they had been hatched there.

"Mr. Lockwood stated in his report (see last Annual Report of this Department) that even the common ragweed (*Ambrosia artemisiæfolia*) was eaten clean by the worms, and also that the worms in passing through a strawberry patch devoured both the leaves of the plant and the unripe fruit.

In order to establish upon proper authority the facts concerning what the army worm will and will not eat when pushed by hunger, we conducted during the summer of 1881–'82, a series of experiments upon different plants, placing each plant in a separate breeding-cage with a few healthy half-grown larvæ. The results show an unexpected power of accommodation to plants in many families, and no resultant variation in the imagines worth mentioning.

The results are summarized below:

PAPAVERACEÆ.—*Papaver somniferum.* (Garden poppy.)

Of four larvæ all attained full growth and entered the ground. Three moths issued.

CRUCIFERÆ.—*Brassica oleracea.* (Cabbage.)

The four larvæ in this case moved restlessly about for the first day without feeding. The second day they began to feed, and by the fifteenth all had changed to pupa. In this state two died, but the other two issued as moths.

CRUCIFERÆ.—*Raphanus sativus.* (Radish.)

Of four larvæ two lived to issue as moths; one died in the pupa, and one in the larva state.

MALVACEÆ.—*Gossypium herbaceum.* (Cotton.)

All died after feeding slightly.

VITACEÆ.—*Vitis labrusca.* (Grape.)

All died without feeding.

LEGUMINOSÆ.—*Pisum sativum.* (Garden pea.)

Of five larvæ all fed abundantly; transformed and issued as moths.

LEGUMINOSÆ.—*Phaseolus vulgaris.* (Garden bean.)

All died without touching the leaves.

ROSACEÆ.—*Fragaria virginiensis.* (Strawberry.)

The four larvæ experimented on all fed for from seven to ten days and then died without transforming.

ROSACEÆ.—*Rubus strigosus.* (Raspberry.)

Of eight larvæ all fed well and all transformed to pupa; only four, however, issuing as moths.

UMBELLIFERÆ.—*Daucus carota.* (Carrots.)

The four larvæ begun feeding on the second day; all transformed; two died in the pupa state and the other two issued as moths.

UMBELLIFERÆ.—*Pastinaca sativa.* (Parsnip.)

Of four larvæ one died before transforming, one in the pupa state, and the other two issued as moths.

COMPOSITÆ.—*Lactuca sativa.* (Garden lettuce.)

Of four larvæ one was destroyed by the others before they commenced to eat; the others all fed to full growth, transformed and issued as moths.

CHENOPODIACEÆ.—*Beta vulgaris.* (Garden beet.)

Of four larvæ, after feeding slightly, three died after six days; the remaining one fed more extensively, transformed to pupa and issued as an apparently healthy moth.

LILIACEÆ.—*Allium sativum.* (Onion.)

All fed; two died as larvæ, and the other two completed the round and issued as moths.

CONIFERÆ.—*Abies canadensis.* (Hemlock.)

All died without feeding.

SALIVARY AND OLFACTORY ORGANS OF BEES.—P. Shiemenz in this elaborate paper commences with the ordinary bibliographical résumé; he describes in detail the structure of the parts of the digestive tract which bears on the question of the salivary glands, and discusses their developmental history and their function. He points out that all glands have to supply a secretion, and that the more the separate cells take a larger share in this, the richer the secretion from a smaller number of secreting cells. In bees there are two essentially different modes by which this is effected and the two types may be appropriately spoken of as the *intracellular*, and the *intercellular*. In the simplest case of the latter we find a sac lined by a simple layer of cells, so arranged that each cell presents a proportionately broad surface to the common cavity; the material is obtained from the blood at the opposite ends of the cells. If the sac elongates, its diameter diminishes and we get the tubular form. In these two "systems" the cells are widest in a direction parallel to the lumen of the sac or tube. If the cells become spheroidal, there is a proportionate diminution in the secreting surface, and efferent canals appear between the

cells. As a matter of fact, glands of this kind of construction do, among the Apidæ, stand remarkably close to the sacular or the tubular.

The intracellular type obtains in what the author calls his first, fourth and fifth system; here the cells are attached to long stalks and float in the collum, and thus it happens that the whole of their surface is able to take up the necessary matter from the blood. In connection with consequent large secretion, secretory canaliculi are developed, which make their way into the cells, surround the plasma, and so afford a correspondingly large surface for excretion. To this type a much greater secretory activity must be ascribed than to that in which secretion is intercellular. In the so-called fourth system we find that the intercellular spaces are very rare, and in the first (Bombus) the free cells are arranged in acini. Both these arrangements must be due to the large number of cells present.

The author concludes that the so-called crop has, in honey bees, the function of, at times, completely shutting off the honey-stomach from the chyle-intestine, while the small intestine forms the means of communication between the latter and the rectum. The salivary glands vary considerably both in genera and species, and it seems proable that their functions are also very varied. While one system of glands is formed within the *propria* of the first portion of the larval spinning glands, two others are derived from its efferent canals, and the other two are fresh structures formed by an invagination of the epidermis. The olfactory mucous gland of Wolff is salivary in function.

Entomological Notes.—J. Nusbaum discusses in the *Zoologischer Anzeiger*, Jan. 7, the structure, development and morphology of Leydig's chorda, or so-called ventral vessel of Lepidoptera, which has lately been treated of by Burger and by Cattie. Nusbaum concludes that the chorda is a mesoskeleton; that it is analogous to, but not homologous with, the chorda of vertebrates, and that we may distinguish in the arthropoda, as in the vertebrates, two morphologically different parts in the internal skeleton: 1, an endoskeleton (endodermal chorda and its products); 2, a mesoskeleton (*i.e.*, Leydig's chorda).——Fritz-Müller describes in the same journal (p. 415, 16) the appendages of the abdomen in *Acræa thalia*.——Mr. A. E. Butler discusses the moths of the "Family Urapterygidæ" in the collection of the British Museum. Why the category of a family should be applied to what appears to us to be scarcely a sub-division of a sub-family of geometrids shows to what extremities systematists of an exceedingly analytical turn of mind will sometimes go. Why should not the inspection of such immense collections as those of the British Museum lead to broader taxonomical views?——The late Hermann Müller treats in *Kosmos* of the intelligence of the honey bee, and its difference in different races.——"Ants and their Ways" is the

title of a little book by W. F. White, published by the London Religious Tract Society.——The prolonged existence of Ichneumon in the pupa state is noticed by W. McRae in the *Entomologist*, p. 188.——Several interesting papers on the Collembola, by G. Brook, have appeared during the past year in the Journal of the Linnæan Society of London; among others a revision of the genus Entomobrya, of which Degeeria of Nicolet is a synonym. Packard's *Degeeria 10-fasciata*, a common U. S. species, is referred to the common European *Entomobrya multifasciata*, of which Say's *Podura fasciata* is also regarded by Mr. Brook as a synonym.

ZOÖLOGY

NOTES ON MEDUSÆ — *(Continued from February number).*— *Stomatonema reticulatum*, n. g. and s.—I have given the name of *Stomatonema reticulatum* to a new Discophore from the South Atlantic, which has affinities with Cassiopea, Aurelia, and others, and seems to me to throw considerable light on the homologies of certain peculiar bodies called "crests," found on the oral cylinder of that curious genus from the Florida Keys, known as Stomolophus.

The body is an inch and a half in diameter, is rounded, bell-shaped above, with thick gelatinous walls. The margin of the bell is much thinner than the central region, and on its floor is a fine reticulation of anastomosing tubes. The region of this network of tubes forms a narrow zone, whose outer edge is the bell margin. There are no marginal tentacles as in Cassiopea and some other related genera of Discophora.

The marginal sense-bodies are more closely allied to those of Aurelia than to the same structures in Cyanea or Rhizostoma. The sense-bodies are eight in number, placed at regular intervals about the rim of the bell. Each sense-body is covered with a hood, and on either side, continued for a short distance beyond the sense-bulbs, is a lappet similar to like structures in the genus Aurelia. In addition to the zone of anastomosing tubes mentioned as being found on the bell margin, there are other vessels which arise from the central stomach cavity, and pass directly without bifurcation to the inner rim of the marginal network. Between these last there are still others, also straight and unbranched, which arise from the inner rim of the marginal net of tubes and extend centripetally, ending blindly in the bell substance on the lower floor.

The oral appendages of Stomatonema are characteristic. They hang from the lower floor by four attachments, in the intervals between which are placed the large globular ovarian sacs. The oral appendages are small, eight in number, and have a remote likeness to those of Aurelia. On the under side of each a groove is formed between two wing-like folds, which hang down and

border the canal on each side. These folds are continued around the oval tentacles at their distal ends, extending for about half the length of the tentacle on the upper side, and enclosing on this side a canal similar to that found below. On the edge of each of these folds there is placed a row of suckers, or " mouths," which resemble the well-known mouths in Aurelia, Cassiopea, and other similar Discophores. Each oral tentacle is thus bordered above and below by a double row of these sucking mouths. The signification of my emphasis of this fact will be seen when we come to consider their homologues in the strange genus Stomolophus.

A system of vessels for the transportation of the food from the sucking mouths to the central stomach cavity pervades the oral tentacles. Through the middle of each tentacle there passes a tube, which takes up alternately from upper and lower sides smaller vessels, passing to it from the superficial canal on the lower and likewise from that already described on the upper edges of the oral tentacles. As it nears the common fusion of all the oral tentacles, the median vessel of each tentacle becomes superficial, and opens into the groove with which it is continued on the lower surface of the oral apparatus, until ultimately it passes through a common central orifice into the stomach cavity. The two regions of suckers found on the oral tentacles we may designate as the upper and lower regions; the former being simply a continuation of the latter around the distal end of each oral appendage. The upper region of suckers is therefore morphologically the same as the lower, with which it stands in direct communication. In Aurelia the lower region of suckers ends on the lower side of the oral tentacle near its distal extremity. Does its continuation on the upper side in Stomatonema mean anything when we study the distribution of these bodies in some other genera?

The genus Stomolophus, found in Floridan waters, is a Discophorous medusa of which little is yet known, either as regards its anatomy or embryology. As far as our limited knowledge of the structure of their umbrella goes, there are many points of resemblance in the two genera. Both have the same bell-shaped bodies, and both are destitute of tentacles on the bell margin. Stomolophus is represented in the well-known figure in Professor L. Agassiz' " Contributions to the Natural History of the United States," with a reticulated zone surrounding the bell margin, which may correspond with the reticulated zone of tubes in our new genus.

In the structure of the oral region the two genera seem widely different, for while in Stomatonema we find this organ composed of eight oral tentacles, each of which is wholly distinct from the others, in Stomolophus there is a consolidated oral cylinder crossed by longitudinal lines of " crests," of which there are eight pairs. Of these crests there are two kinds, an upper, arising

from the sides of the oral cylinder which, as the medusa swims through the water, is almost wholly concealed by the sides of the bell, and a lower, in anatomical structure resembling the last, and also arranged in eight pairs in a similar manner. They are, however, disconnected from the upper, and are situated at the distal end of the oval cylinder. These "crests," particularly the upper, are raised folds or lips thrown into many ruffles, and are vertically arranged on the oral cylinder; the lower extending around the marginal rim into the mouth cavity of the cylinder. Professor Agassiz has already shown that the oral cylinder of Stomolophus may be looked upon as the homologue of the eight consolidated arms of the Rhizostome medusa. If we imagine the eight oral tentacles of Stomatonema consolidated into an oral cylinder, we would have almost exactly the morphology of the mouth-parts of Stomolophus. In that consolidation the vertical "crests" are what remains of the upper region of suckers and the lips upon which they arise, while the lower "crests" or ruffles are representatives of the lower lips and their appendages. In the fancied consolidation we must suppose a small partition between the upper and lower lines of sucking mouths, the upper crests being separated from the lower by an unbroken and consolidated section of the oral cylinder.

The genus Stomatonema approaches more closely Stomolophus than any of the Rhizostomidæ, and seems to me to confirm the theory that the formation of the oral cylinder of the latter is homologous with the consolidation of the oral tentacles. Whether this morphology of the organ in question is supported by the course of the development of the mouth must be proved or disproved by those who have opportunities to study this not uncommon medusa in Floridan waters, or on the Carolinian or Georgian coasts.

The genus Stomatonema was taken in Montevideo harbor, and a type specimen is in the Mus. Comp. Zoöl. at Cambridge.

Glossocodon and Cunina.—The interest attached to the commensalism of Cunina and Glossocodon, in which colonies of the young of the former genus are attached to various regions of the body and stomach of the latter, and the fact that both of these genera are found in North American waters, leads me to publish the accompanying sketch made several years ago (1878) at Villa Franca. Although the commensalism of Cunina and Glossocodon has never been observed in our North American representatives, the late Professor McCrady many years before (1856–7) discovered in Charleston harbor a *Cunina octonaria* McCr., whose young lives in the bell cavity of a genus to which he gave the name of Turritopsis. It remains yet to be seen whether our species of Glossocodon and Cunina have that same intimate relationship which has been described in the Mediterranean species

by Haeckel,[1] Uljanin, F. E. Schultze, and others, between the genera Caramina and Cunina. Fritz Müller has described a like commensalism in Glossocodon (Liriope) and Cunina from South American waters. Later investigations may show that our species are the same as his, and probably stragglers from warmer southern waters. To those especially whose good fortune it is to cultivate the study of the Medusæ of these localities, we must look for new observations. On the New England coast both genera are very rare. The genus Carmarina, which has six radial tubes while Glossocodon has but four, has not been found in our waters, but from Fritz Müller's observations of *Glossocodon catharinensis*, we may expect the same or a similar commensalism in our species of the same genus.

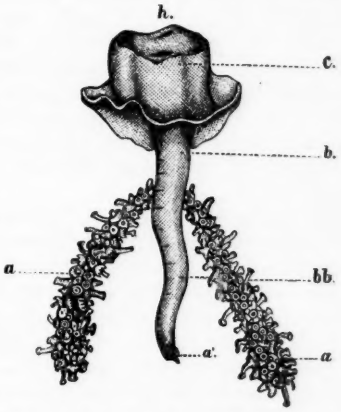

FIG. 7.—The free extremity of proboscis of Carmarina, with stomach walls cut off and tongue "columella" protruded; *a, a*, colonies of Cuninæ; *b, bb*, "Tongue" (extension of peduncle of the proboscis); *c*, base of the tongue and union with proboscis; *h*, section of the proboscis at the point where it is cut off from the attached part.

Although I have searched in vain for this relationship in our genera, many specimens of Carmarina with Cunina colonies were found during my stay in Villa Franca, where both these genera are represented more abundantly and by much larger species than those thus far known from this side of the Atlantic. My drawing of one of these, although in essentials very similar to those published by Haeckel and Schultze, shows in the same host colonies in different stages of development, where one of the three *(a)* has not yet developed a stolon, and has not advanced beyond a simple medusa form. It has a very long proboscis, a diminutive bell, and is almost identical with the youngest *Cunina octonaria* figured by Professor McCrady.

The cut (Fig. 7) represents the "tongue" *(b, bb)* of Carmarina and the terminal extremity of the proboscis *(h)*, from which it hangs. The tongue is a transparent gelatinous prolongation of the peduncle of the medusa, very similar in consistency to the wall of the umbrella, and is suspended within the stomach, protruding a little beyond the lips of the same. In order to show its whole extent, certain dissections have been necessary. The stomach walls have been removed—cut away—in order to

[1] The conception of the relationship of the two genera known as Allœogenesis which Haeckel first advanced has been shown to be erroneous.

expose this organ and its appendages, the Cunina colonies, more clearly, so that only the line of their former attachments is represented. Upon the tongue will be observed on each side an elongated cluster *(a)*, made up of spherical, flask-shaped and star-like bodies, each of which, when magnified slightly in size, will be found to be a medusa of different form from its associates, since in different stages of growth, but all attached to a common stolon which itself hangs from the tongue of the Carmarina. These clusters or colonies of young Cuninæ, as is well known, ultimately dissolve their connection with the stolon and swim away as free medusæ.

As my object in the introduction of this cut is simply to call attention to a mutual relationship of the two genera, both of which occur in our waters, I will not consider many theoretical points which are closely connected with this relationship. Let me, however, point out the very close likeness between such a colony of young Cuninæ and a Siphonophore. I have been able to confirm an important observation of Uljanin's that the Mediterranean species of Cunina does not always attach itself to the tongue of Carmarina, but is sometimes found fastened even to the walls of the umbrella. Such observations would seem to show that attachment to the tongue is not essential to the life of the young Cunina colonies. Must it necessarily be supposed that the young Cunina cannot also fasten itself to another medusa, as Professor McCrady has shown *C. octonaria* clings to the inner bell-walls of Turritopsis? If attached to the bell of Carmarina it can get little of the common food with its host. In this case is it anything more than a parasite or is it a true commensal? Observation must yet show that the attachment of one to the other is necessary for the life of either.

In studying a specimen of Carmarina with Cunina colonies, I separated one of these colonies of Cunina from Carmarina, and found that it lived some time in that condition. It, however, died before any of the buds attached to the stolon developed into free medusæ. The difference between such a colony of Cuninæ separated from its attachment and a Siphonophore is morphologically very small. If we go back in the embryological history of both, we find in the "primitive larva" of a genus of Siphonophores called Agalma a stage not widely different from the youngest medusa *(a)* immediately after it has become attached to the tongue, and prior to the formation of the stolon. The morphological resemblances between a free medusa (gonophore) and a simple fixed hydroid are very great, so great, in fact, that many naturalists have looked upon the comparison of the Siphonophore to one or the other as essentially the same thing. While, without doubt, we must regard the attached Cunina colonies as representing a hydroid stage, they seem to me to resemble more closely a budding Lizzia or Sarsia than a fixed

hydroid. Cunina has become degenerated by its parasitism or commensalism so that the proboscis with young budding from it alone remains. Its bell has gone, the mouth opening is no longer functional, and the proboscis, which has elongated into a stolon attached to the body of a host, is closely crowded with the young. The modifications which the same stolon undergoes in the Siphonophores, where it is elongated into the axis, and the changes which take place in the bell of the primitive Lizzia, by which a float or air bubble results, has been sufficiently discussed elsewhere. The most widely aberrant forms of development among the Siphonophores can be made uniform if we compare them with that of the budding Sarsia and Lizzia as the normal type. That exceptional form of development called alternation of generation which exists in the fixed hydroids may be regarded as the irregular, not the normal, method. It is an adaptation resulting from peculiar circumstances, and a departure from a rule in one direction as that of the Siphonophores is in another. The Cunina colonies have resemblances with both fixed hydroids and Siphonophores, but have not departed as widely as either from the normal method in their older larval and adult conditions.—*J. W. Fewkes, Cambridge, Dec., 1883.*

A New Pelagic Larva.—While engaged in the study of the larvæ of our marine Annelids, my attention has been directed to the close resemblance which many of them bear to the young of the Polyzoa, more especially of the entoproctous genera, Loxosoma, and Pedicellina. Several points of resemblance between Actinotrocha, the young of a Gephyrean genus called Phoronis, and the former of these two polyzoan genera in the adult condition have already been suggested by others, while the relationship between the young of the Chætopods, and the larvæ of Polyzoa have been repeatedly commented upon by those who have studied the development of both these groups of animals. The larval Chætopod worm which most closely resembles the young of Loxosoma is the well-known Mitraria, the comparisons between which have been nowhere more concisely made than by Balfour, in the first volume of his Comparative Embryology. To prove any genetic relations between these groups, other worm larvæ, even more closely related to the Polyzoa than Mitraria, ought to be discovered, and it would seem self-evident to every one that before any intimate connection between the Vermian and Polyzoan phyla can be satisfactorily made out, that a larger number of intermediate larval forms of one group or the other should be found. Such a larva, which seems to me to fill in part the gap in our comparison of the larval Annelid and the young Polyzoan, I have taken several times at Newport, and although I am at present ignorant of the adult form which it attains, it seems to me of more than ordinary interest as having to a greater extent than

any known larva, characteristics of the young of both the group of Chætopods and that of the Marine Polyzoa.

The identification at present accepted of the genus into which Mitraria is developed, is not wholly satisfactory. Mitraria was first found figured and described by Johannes Müller.[1] He speaks of three species, and regards them as the larvæ of some Annelidan genus. The next naturalist in order of time who studied Mitraria was Claparede,[2] who fished the animal with the dip-net on the coast of Scotland. Neither Müller nor Claparede observed the transformation of the larva which they had found into a worm or had anything more than a speculative knowledge of the genus to which it belongs. Schneider[3] was the first to observe a new stage in the development of Mitraria. He found that this larva, when left in his glasses, was replaced by one which he considered approximately in form that of a Gephyrean. Kowalevsky, however, according to Metschnikoff, had determined the Chætopod nature of Mitraria in 1867, although he had not published his discovery. The last step in the history of the attempts to determine the adult of Mitraria we owe to Metschnikoff,[4] who traced it into a Chætopod belonging to the family of Clymenidæ. Although he was not able to determine the genus of Annelids into which it developed, he traced it into a tubicolous worm, which has many resemblances to some of the genera of this family.

Of all known worm larvæ, that which we are about to describe has the closest likeness to Mitraria.[5] It is, however, still very far removed from it in many points of structure.

The Polyzoan larva, which it approaches most closely is Cyclopelma, the young of Loxosoma.[6] *Cyclopelma longiciliatum* was first described by Busch,[7] who was, however, unable to determine satisfactorily the adult form. Leuckart[8] first suggested that Cyclopelma is the young of the entoproctous Polyzoan, Loxosoma. The new larva which I am about to describe has many affinities with Cyclopelma, as well as with Mitraria, and seems intermediate between the two.

The general form of our new larva is as follows:

Its body has an elongated, oval shape, girt equatorially by a swollen belt (*cb*) upon the margin of which the cilia are borne.

[1] Arch. f. Anat. u. Phys., 1854, p. 88, Pls. v, vi.

[2] Zeitschr. f. Wiss. Zool., x, p. 407.

[3] Arch. f. Mikros. Anat., v (1869), p. 271.

[4] Zeitschr. f. Wiss. Zool., xxi, p. 233, Pl., xviii.

[5] A new Mitraria of large size, differing from any yet described, was found by me in the Bermudas in May, 1882.

[6] Let me add to Dr. Leidy's list of localities where this parasite is found, the New England coast, on Sipunculus; Professor Verrill also reports it from New England coast. (Preliminary Check-list.)

[7] Beobach. über Anat. u. Entwick. wirbellos, Thiere, 1851.

[8] Arch. f. Naturg., 1867, p. 304.

This belt, when the larva is looked at from either extremity, is oval, and has its margin deeply indented with a notch (*m*) on one side. It divides the larva into two halves of unequal size, which may be called the anterior (*a*), and the posterior (*b*). The anterior is hat-shaped and rounded at the apex. It is sometimes stretched into a thimble form (Fig. 3), at which time the belt is turned backward so that it almost wholly conceals the posterior half of the body.

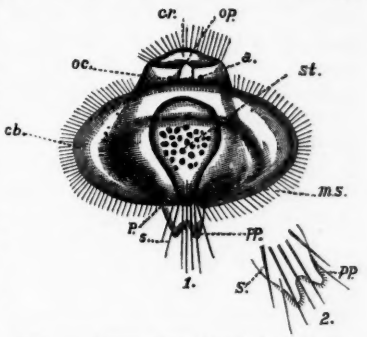

FIG. 1.—Larva from dorsal side; *a*, anterior hemisphere; *cb*, ciliated belt; *cr*, ciliated apex; *ms*, pigment; *oc*, ocellus; *op*, apical projection; *p*, posterior hemisphere; *pp*, ciliated caudal prominences; *s*, setæ; *st*, stomach. FIG. 2.—Ciliated prominences, and lower extremity of larva.

The apex of the upper half of the body is rendered very prominent by reason of a tuft of cilia (*cr*). In one specimen (Fig. 1) these cilia appeared to be set on the edge of an orifice, which was widely open and bore every resemblance to a mouth. A small median prolongation (*op*) of a ridge on one side was noticed. In the walls of the larva near by was a pair of reddish pigment spots (*oc*). The union of the upper half of the embryo and the ciliated belt is marked more especially on the ventral side by opaque walls caused by pigment (*ms*) of a black color.[1] The posterior body region is smaller and more pointed than the anterior, and tapers uniformly from its fusion with a ciliated belt to two small appendages (*pp*) at the lower pole, or posterior extremity of the larva. The posterior body region is unsegmented, and the papilliform caudal appendages are covered with fine cilia. A vent opens posteriorly between these two appendages, out of which fœces were observed to pass. On the side of the posterior half of the body, opposite that in which the notch (*m*) in the margin of the ciliated belt is found, several long spines (*s*) arise, which, although not as long, resemble in general characters the spines in Mitraria. They do not spring from a single or double[2] protuberance as in Mitraria, but are appended to the side of the posterior part of the body which bears the ciliated papillæ. The true mouth was very difficult to discover, but in single specimens it could be seen in the region just below the ring of cilia in the indentation already spoken of in the margin of that structure.

[1] This pigment calls to mind the "Mesoderme oral," in the figures of young Polyzoa by Barrois (Recherches sur l'Embryologie des Bryozoaires, Lille, 1877).

[2] See figures of species of Mitraria by Müller. In Metschnikoff's species there is a single prominence upon which the setæ arise.

The body walls, for the most part, are opaque, especially in the region of the ciliated belt, which encloses some of the most important vital organs. Within the body, however, a globular, orange-colored mass (*st*) could be seen, and from it a continuation (intestine) leading downward into the posterior body region. The œsophagus, if seen, was not recognized. The upward prolongation of the walls in which the orange mass is found, as shown in a specimen with the upper hemisphere extended, was at first thought to be an œsophagus, but afterwards it was referred to a similar placed organ in Mitraria.

There are several doubtful and many anomalous features in the larva which we have described above.

The position of the internal organs, upon which so much depends in the identification, could not, from the limited material at my disposal, be satisfactorily determined. It is contrary to all homology with other Metachætæ, that the mouth should be situated at the apex of the upper hemisphere, by which the larva

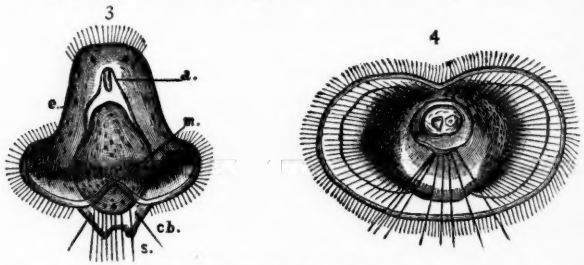

FIG. 3.—Larva with ciliated belt turned backward (ventral view); *m*, mouth.
FIG. 4.—Ciliated belt seen from below.

would be made mesotrochal. All homology with Mitraria would point to a region just below the ciliated band as the probable situation of this organ. If it really does exist here the ciliated zone at the apex of the larva would be exactly homologous to that ectodermic thickening which is described by Metschnikoff as found at the apex of the upper hemisphere of the Mitraria. This apical unfolding of the wall of the body would then have an entirely different meaning from the interpretation that it is a mouth, and the cilia would be regarded as homologous to that well-known tuft found in so many genera in an homologous position.

The two ciliated protuberances (*pp*) on the posterior part of the body resemble closely similar appendages in several genera of Chætopoda. They are not found in Mitraria nor in the Polyzoan larvæ. In connection with their absence in the former genus, and their existence here, it may be well to quote one of the closing sentences in Metschnikoff's article (*op. cit*) on the development of Mitraria. He says: "Die Abwesenheit der analen Papil-

len bei unserem Wurme kann schon deshalb nicht gegen die Clymenidennatur desselben augeführt werden, weil wir ja mehrere Repräsentanten dieser Familie (Z. B. Clymenides Clap. oder Clymenia Qtrf.) ohne die charakteristische Schwanzbildung der echten Clymenen kennen." If our larva be the young of some member of the Clymenidæ, the ciliated projections may be two of the characteristic papillæ of this region of the adult.[1]

Our unknown larva has one highly characteristic Polyzoan feature. The ciliated belt is reflexed over the lower half of the body in the same way that an homologous structure is turned back in the larval Polyzoan, Cyclopelma, mentioned above. The spines appended to the posterior region of the body are probably temporary, and are homologous with the embryonic setæ in Spio, Prionospio and several other genera. They approximate nearer the setæ of Mitraria as far as position goes, although they are not mounted on any special prominence, and arise from the posterior body region which bears the terminal ciliated prominences. In Mitraria there are no eye-spots similar to those which have been described in our new larva. In the young Loxosoma there are two well marked ocelli.

As only a single stage in the development of my new larva was found, it is impossible to do more than speculate in regard to the genus of which it is the young. There is no doubt that it is a larval Annelid, but I am at a loss to what family of Chætopoda it should be referred.—*J. Walter Fewkes.*

Barn Owls in Missouri.—As in several other parts of the country, there has been an unusual occurrence of numbers of the barn owl here this winter. Specimens were captured in four different buildings in the city and one in the country. A number of them made a regular resort of an unused chimney in a residence near the centre of the city.—*F. A. Sampson, Sedalia Natural History Society, Sedalia, Mo.*

Notes on the Red-wing Blackbird.—I examined to-day five nests of this bird *(Agælæus phœniceus)* in a prairie, though near my residence. There was but one egg in one of the nests, three in another, and four in another. One nest had a very young bird and three eggs, while the fifth nest contained four little birds about one-fourth grown. All of these but one, I am confident,

[1] It is very difficult to reconcile the hypothesis of Metschnikoff, that the Mitraria is a larval stage of a genus of Clymenidæ, and the larvæ of Clymenella figured and described by Dr. E. B. Wilson (Stud. f. Biol. Lab. Johns Hopkins Univ., Vol. II, No. 2). In none of the figures given in the excellent embryology of this worm by the latter author have I been able to find a larva which could be referred to a "Mitraria stage." If Clymenella be placed in the family of Clymenidæ, and Mitraria be the young of another member of the same, we evidently have two very different modes of development, or rather, two radically different forms of larvæ in the two. Until a larger number of older larvæ of Mitraria are known, its reference by Metschnikoff to the Clymenidæ must remain more or less hypothetical.

were old nests, which had undergone slight repairs, so that the poet Longfellow, when he wrote—

"There are no birds in last year's nests,"

could not have referred to the red-wing blackbird. These nests were built among the cat-tail flags and coarse grass and reeds, which grow in the water. One of the nests was suspended upon green supports, while in the others the supporting stalks were all dead. The first-mentioned nest was evidently of recent construction, while the others had been used at least one previous season.

Opinion has varied much in the past in regard to the usefulness of this much persecuted bird. The fact that he was in the habit of eating some corn, just as it was hardening out of the milk, created a deep-seated prejudice among superficial observers years ago; but "the authorities" are all of one accord in the idea that it is one of our most useful birds. Wilson, in his time, estimated that the red-wings annually consumed in this country the vast aggregate of 16,000,000,000 of insects, the most of which were noxious! So much good work as that surely should entitle this beautiful bird to the fullest measure of protection.

But I am of the opinion that the red-wings have seen "their best days" in several of the Northern States. Some observers have occasionally found their nests in trees and bushes, and others upon the ground. But in the great prairie States its favorite nesting place is among the rank vegetation of the sloughs, ponds, and the margins of shallow lakes. But settlement and cultivation are resulting in the annual reclamation of thousands of acres of these wet lands, and just now there is springing up in many regions almost a mania on the subject of tile-drainage. As all this progresses the prairie sloughs and ponds will become dry land, and cease to be the summer resorts of the red-wings. They will gradually retire and betake themselves to other and, doubtless, far-distant localities. This region has been settled about twenty-five years, and in that time I am confident that there has been quite a diminution in the vast numbers of these birds. At the present time there is little if any complaint of their raids upon the corn-fields, concerning which much was said twenty years ago. During the next decade tile-drainage and tillage will work very marked changes in the summer homes of this species, as well as its frequent associate the yellow-headed blackbird (*Xanthocephalus icterocephalus*), and many regions where they are now very abundant will doubtless only know them as occasional visitants or "birds of passage."—*Charles Aldrich, Webster City, Iowa, June 7, 1883.*

Migration of North American Birds.—At the first congress of the American Ornithologists' Union, held in New York city, Sept. 26–28, 1883, a committee on the migration of birds was appointed to investigate, in all its bearings and to the fullest extent

possible, the subject of the migration of birds in the United States and British North America. The work will not be limited to the accumulation of records of the times of arrival and departure of the different species, but will embrace the collection of all data that may aid in determining the causes which influence the progress of migration from season to season. For example, severe storms, gales of wind, protracted periods of unusually high or low temperature (for the locality and time of year) are among the atmospheric conditions that are known to exert marked effects upon the movements of birds. The opening of the leaves and the flowering of certain plants, with the correlative appearance of a multitude of insects, are also among the actors that have to do with the abundance of many species. Hence the careful registration of certain meteorological phenomena, and of the state of advancing vegetation from day to day, will constitute prominent items in the record books of the observer.

For the purpose of rendering the result of the season's work as full and valuable as possible, the committee earnestly solicits the coöperation of every ornithologist, field-collector, sportsman and observer of nature in North America. Indeed, a large corps of observers is absolutely essential to the success of the undertaking, and the committee hopes to receive substantial aid from many who profess no knowledge of ornithology. Efficient service can be rendered by those familiar with only our commonest birds, and the committee will gladly accept data concerning any of the following well-known species:

Robin, mocking bird, catbird, brown thrasher, bluebird, house wren, yellow-rumped warbler (myrtle bird), yellow-breasted chat, redstart, Maryland yellow-throat, cedarbird (waxwing, cherry-bird), purple martin, barn swallow (fork-tailed), violet-green swallow, scarlet tanager, pine grosbeak (bullfinch), purple finch, redpoll linnet, yellow bird (thistle bird), snow bunting, Eastern chewink (towhee), junco (slatebird), cardinal redbird, rose-breasted grosbeak, indigo bird, bobolink (ricebird), cowbird, yellow-headed blackbird, red-shouldered blackbird, meadow lark, oriole (hanging bird), crow blackbird, horned lark (shore lark), kingbird (bee martin), pewee (phœbe), Eastern humming bird, Eastern chimney swift, whippoorwill,[1] nighthawk,[2] kingfisher, fishhawk, wild pigeon, also any of the waders, "shore birds" and ducks.

Plan of the Work.—For convenience in collecting and arranging the enormous mass of material which will be accumulated by the joint labors of this army of field workers, it has been deemed advisable to divide the vast expanse of territory embraced in the United States and British North America into thirteen districts, each of which will be placed under the immediate direction of a

[1] When first heard.

[2] When first seen.

competent superintendent. The districts, with their respective superintendents, are:

Alaska—Supt., John Murdoch, Smithsonian Inst., Washington, D. C.

Northwest Territories—Supt., Ernest E. Seton, Assinaboia, via Carberry, Manitoba.

Newfoundland—Supt., James P. Howley, St. John's, Newfoundland.

British Columbia—Supt. (not yet determined).

Manitoba—Supt., Professor W. W. Cooke, Caddo, Indian Territory.

Canada—Supt., Montague Chamberlain, St. John, New Brunswick.

Atlantic seaboard (Lighthouses and lightships from Canada to the Gulf of Mexico)—Supt. (not yet determined).

New England—Supt., John H. Sage, Portland, Conn.

Atlantic district (New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, North Carolina. South Carolina)—Supt., Dr. A. K. Fisher, Sing Sing, New York.

Middle-Eastern district (Southern Michigan, Indiana, Ohio, West Virginia, Kentucky and Tennessee east of the Tennessee river, Alabama, Georgia and Florida)—Supt., Dr. J. M. Wheaton, Columbus, Ohio.

Mississippi valley—(Dakota, Minnesota, Wisconsin, Nebraska, Iowa, Illinois, Kansas, Missouri, Indian Territory, Arkansas, the small portions of Kentucky and Tennessee west of the Tennessee river, Texas, Louisiana, Mississippi)—Supt., Professor W. W. Cooke, Caddo, Indian Territory.

Rocky Mountain district (Idaho, Montana, Wyoming, Utah, Colorado, Arizona, New Mexico)—Supt., Dr. Edgar A. Mearns.

Pacific district (Washington, Oregon, California, Nevada)—Supt., L. Belding, Stockton, Cal.

The home of each observer is called a station, and is recorded by number upon the books of the committee. The committee particularly requests that all persons who read this circular, and are willing to aid in the work, will immediately communicate with the superintendents of their respective districts. Those residing in districts whose superintendents have not as yet been named, may address the chairman.

It is the duty of each superintendent to exert himself to the utmost to increase the number of observers in his district; to answer the questions they may put to him concerning the details of the work, etc.; to collect at frequent intervals the product of their labors; to ascertain from these data the whereabouts of certain species in winter and the times of leaving their winter homes; to determine, if possible, the number and extent of the chief avenues of migration within the limits of his district, and the average rate of speed at which the different species travel; to locate the breeding areas of the summer residents; and, finally, to submit the result of the season's work to the chairman of the committee. The chairman shall, in turn, arrange, condense and systematize the material received from the superintendents of the several districts, and shall present to the union the fruits of the joint labors of all the collaborators, together with any comments, deductions or generalizations he may have made upon the same.

INSTRUCTIONS TO COLLABORATORS.—The data collected may conveniently be arranged in three general classes: *a*. Ornithological phenomena; *b*. Meteorological phenomena; *c*. Contemporary and correlative phenomena.

(*a*) *Ornithological phenomena.*—Each observer is requested to prepare, at his earliest convenience, a complete list of the birds known to occur in the vicinity of his station, and to indicate (by the abbreviations enclosed in parenthesis) to which of the following five categories each species pertains :

1. *Permanent residents*, or those that are found regularly throughout the entire year (R).

2. *Winter visitants*, or those that occur only during the winter season, passing north in the spring (WV).

3. *Transient visitants*, or those that occur only during the migration in spring and fall (TV).

4. *Summer residents*, or those that are known to breed, but which depart southward before winter (SR).

5. *Accidental visitants*, or stragglers from remote districts (AV).

It is desirable also to indicate the relative abundance of the different species, the terms to be employed for this purpose being: *Abundant, common, tolerably common, rare.*

In many species the males arrive in advance of the females, hence it is important to note the sex of the first comers, and the date at which the opposite sex is first seen.

In recording arrivals and departures it is highly important to distinguish between the movements of the great bulk of the species and those of the forerunners or advance guard. For this purpose two dates should be recorded for the incoming, and two for the outgoing of every non-resident species, as follows :

1. The first appearance of the species (F).
2. The arrival of the bulk (BA).
3. The departure of the bulk (BD).
4. The last individual seen (L).

In addition to the above, which may be regarded as essential data, there are many other noteworthy details that bear more or less directly upon the complicated problems involved in the study of migration. Among such may be mentioned the bodily condition of the bird (whether fat or lean), the molt and the periods of song. The time of mating, when observed, should always be recorded.

(*b*) *Meteorological phenomena.*—Extended meteorological data are not required, though the observer would derive material assistance from a systematic weather record. The committee desires information upon :

1. The direction and force of the wind.
2. The direction, character and duration of storms.
3. The general conditions of the atmosphere, including rainfall.
4. The succession of marked warm and cold waves, including a record of all sudden changes of temperature.

(*c*) *Contemporary and correlative phenomena.*—The committee desires that the data under this head be as full and complete as possible, and requests exact information upon :

1. The date at which the first toad is seen.
2. The date at which the first frog is heard.
3. The date at which the first tree-toad or "peeper" is heard.
4. The dates at which certain mammals and reptiles enter upon and emerge from the state of hibernation.
5. The dates at which various insects are first seen.
6. The dates of the flowering of various plants.
7. The dates of the leafing and falling of the leaves of various trees and shrubs.
8. The dates of the breaking up and disappearance of the ice in rivers and lakes in spring, and of the freezing over of the same in the fall.

C. HART MERRIAM,
Chairman of Committee on Migration,
Locust Grove, Lewis county, N. Y.

COLOR-MARKINGS OF MAMMALS.—Professor Eimer has continued his studies in regard to the color-markings of vertebrates. As the result of his observations he has laid down certain general

principles which he applies to the different groups, notably to the mammals.

The following general statements are elaborated: 1. That the color-markings of mammals may be reduced to longitudinal stripes, spots, and transverse stripes. 2. That the longitudinal stripes are the oldest form, and that the two follow in course. 3. That the primitive mammalian fauna was a longitudinally striped one. 4. That the males have been first to take on the new forms of marking, while the females hold longer to the older form. 5. That the effects of the law by which the development of the markings takes place from the posterior part of the body toward the anterior part are not so easily traced in mammals as in the case of other groups, such as the Saurians. 6. That in mammals the development of markings follows a regular course, that is, the longitudinal markings are followed by spots which, in turn, run together, and finally form the transverse or tiger stripes. 7. That the position of the smallest spot on a mammal is not accidental, but due to the action of genetic and phylogenetic laws, from which it follows that markings are an available means for the determination of species. 8. That the regularity of the development of markings shows that they arise from constitutional causes.

The author takes the Viverridæ as the original types of the Carnivores, and believes that in the hyena, cats, dogs, bears, and weasels he can trace the form and position of markings possessed by the former. He acknowledges several difficulties, however, in the case of the leopard, jaguar, and other peculiarly spotted cats. He believes that the Ungulates follow the same law in regard to markings as the Carnivores.

Zoological Notes.—*Sponges.*—Mr. Carter (Ann. and Mag. Nat. Hist., Nov.) describes thirteen new species of sponges from various parts of the world.

Cœlenterates.—Dr. R. von Lendenfeld (Ann. and Mag. Nat. Hist., Oct., 1883) gives a valuable description of the guard-animals or nematophores of the Plumularia. He, with Hamann, restricts the term nematophore to the chitinous envelope of the guard-polyp, which is truly a polyp the tentacles of which have become solid, while the stomachal walls have grown together. In Plumularia these guard-polyps are well supplied with urticating capsules, some of those in Aglaophenia and Antennularia have adhesive cells, while some species of Aglaophenia have guard-animals or machopolyps supplied with both urticating capsules and adhesive cells. The writer agrees with Hamann in the belief that the urticating cells of Cœlenterates are not sense-cells, and states that "there exists a continuous connection between the nervous system and the plasma-mantle of the urticating capsule, which is ruptured by the pressure which the plasma-mantle exerts upon it." A preventive excitement may also issue from the nervous system, and paralyze the cnidocil. There is thus exhibited the

commencement of that reciprocal "reflex and preventive action to which modern psychology ascribes such great importance." ——In a recent number of the Bulletins of the Museum of Comparative Zoölogy, Mr. J. W. Fewkes gives a list of thirty-five Medusæ found in Castle harbor, Bermudas, in May and June, 1882, describes the new species *Tamoya punctata* and *Oceanopsis bermudensis*, and gives notes on an unidentified Cladonema, an Ectopleura, and an Ephyra with sixteen tentacles.

Echinoderms.—Mr. F. J. Bell describes (Ann. and Mag. Nat. Hist., Dec.) *Asterias nautarum* from Ecuador, and *Culcita acutispinosa* from Aneiteum, New Hebrides.

Vermes.—In the October issue of the Annals and Magazine of Natural History, Mr. F. E. Beddard has a note upon four species of earthworms from India viz., *Megascolex affinis*, *Perichæta armata*, *Perionyx macintoshii*, and *Typhæus orientalis*, the three last new. The anatomical characters of Typhæus are quite different from those of any other genus before described.

Mollusca.—The efforts of Mr. J. A. Ryder to artificially fertilize the ova of the American oyster have at last proved successful. The sexes of the oyster can be readily distinguished by the "drop test," that is, by the different behavior of a drop of milt, when placed in water, from that of a drop from the ovary of the female. The milt and ova were mixed in a dish, then poured into a pail of water, and then into a pond filled with sea water, which in its passage was compelled to pass through a filter of sand, so as to avoid all possibility of the entrance of germs from the outside. Forty-six days after the experiment was commenced spat from one-fourth to three-fourths of an inch in diameter was found in the pond.——Mr. R. E. C. Stearns, in a letter to the Fish Commission, states that *Glycimeris generosa*, of the western coast of the United States, attains a weight of sixteen pounds, and is probably the largest Saxicavid known, and, next to *Tridacna gigas*, the largest clam in the world.

Fishes.—M. G. Lunel (Ann. and Mag. Nat. Hist., October) describes a case of commensalism between *Caranx melampygus* C. and V., and the Medusa *Crambessa palmipes* Haeckel. The fish was fixed in the cavity formed by the junction of the four columns which unite the stomach of the jelly-fish to the umbrella. A comparison of the notes of various observers leads the writer to the conclusion that Medusæ do not eat small fishes, which their imperfect digestive apparatus could not digest; nor do small fishes eat Medusæ, as other writers have supposed, but that the young of certain fishes, the adults of which live at more or less considerable depths, come up to seek and reside with certain Medusæ.——Miss Rosa Smith (Proc. U. S. Nat. Mus.) has some interesting notes on twenty-five species of fishes taken at Todos Santos bay, Lower California.

Reptiles.—A (?) new species of lizard (*Sceleporus garmani*) is described by G. A. Boulenger, from Dakota, in the Proceedings of the Zoölogical Society of London.——In the Annals and Magazine of Natural History, G. A. Boulenger describes *Lipinia anolis*, from the Solomon islands; *Rhacophorus lateralis*, from Malabar; *Rappia burtonii*, from the Ancober river, Gold Coast; *Bufo andersonii*, from the north of Hindostan (Agra, Ajmere); *Hyla glandulosa*, from Guatemala; *H. macrops*, from Treasury island, Solomon group; *Hynobius lichenatus*, from Awomori, Japan; *Spelerpes peruvianus*, from Moyobamba, Peru; and *Cryptopsophis multiplicatus*, a new genus and species of Cæciliidæ, from the Seychelles. The genus differs from Dermophis in the absence of a second row of mandibular teeth. Fourteen genera of these snake-formed batrachians are now known.

The same naturalist also describes four forms of Lophognathus, two of which are new. *L. maculilabris* is from the Timor Laut islands, the others from Australia.

M. Boulenger also (Ann. and Mag. Nat. Hist., Nov.) notes that three genera of Geckoes (Eublepharis, Coleonyx, and Psilodactylus) have procœlian vertebræ and a single parietal bone, and thus lack the two chief characters on which the suborder Nyctisaura is founded. As the Varanidæ have the orbit incompletely surrounded, and the Helodermatidæ are without the parietal bar, these characters of the suborder also disappear. For these reasons M. Boulenger proposes to retain the group simply as a family under the old name of Geckotidæ, separating from it the three aberrant genera to form the family Eublepharidæ. Eublepharis is Indian, Coleonyx Central American, and Psilodactylus West African, yet all are closely allied both in structure and coloration, and all possess connivent movable eyelids.

Birds.—The Proceedings of the Zoölogical Society of London contains notes filling forty pages on birds collected in the Argentine Republic by E. W. White, edited by P. L. Sclater.——Mr. G. F. Gaumer spent three years exploring Yucatan; his ornithological discoveries are recorded by A. Boucard, with notes by O. Salvin, in the Proceedings of the Zoölogical Society of London. Gaumer's notes on the climate of Yucatan are of much interest, especially those relating to the senotes or underground caves of the country, which appear to be underground rivers.

Mammals.—In a paper on the natural position of the family Dipodidæ, in the Proceedings Zoöl. Soc. London, G. E. Dobson concludes that they are hystricine rodents having the bones of their hind limbs specially modified for leaping, and that their nearest existing allies are the family Chinchillidæ.——Professor R. Owen discusses in the same Proceedings the origin of the keelless sternum of Notornis, by "a combination of circumstances enforced, with operative conditions of organic vitality, first taught us by the immortal author of the Philosophie Zoölo-

gique." The same line of reasoning advanced by Owen applies to the origin of Aptornis and Dinornis.——The bottle-nosed whale is discussed by W. H. Flower and also by Captain Grey in the same journal, which also contains a figure of a new species of zebra (*Equus grevyi*) recently described by A. Milne-Edwards, from equatorial Egypt.

PSYCHOLOGY.

THE DISEASES OF THE WILL.[1]—In the Humboldt Library Mr. Fitzgerald places before the public the results of the latest thought and labor of the scientific world, in a series of 8vo pamphlets costing fifteen cents apiece. This enterprize cannot be too highly commended from the standpoint of the public instructor and lover of knowledge. If the masses are ever to become acquainted with the laws of their being, such a publication as the Humboldt Library will prove a powerful agency in accomplishing the desirable result.

M. Ribot has the merit of stating, in clear and comprehensible language, the facts, doctrines, and hypotheses of modern metaphysics, so that the average reader may be easily introduced to perhaps the most important of all sciences. In this, and other essays on these subjects, M. Ribot pursues the inductive method, studying the mind as it is exhibited in the normal and abnormal types which are accessible everywhere. The important aid to be derived from pathology in mental science is well known. M. Ribot arranges the diseases of the will into several heads, viz: 1. lack of impulsion, as seen in irresolution; 2. excess of impulsion; 3, impairment of voluntary intelligence; 4, caprice; and 5, extinction of will. Under the last head he treats of ecstacy, nirvana, hypnotism, etc. The author shows the intermediary character of the will, that it is not only a cause, but also an effect, thus denying the ordinary form of so-called "freedom of the will." It is difficult to perceive the utility of the word will in this doctrine. As the outcome of a stimulus which has passed through more or less complex emotive or ratiocinative processes, action is only the movement of the last ball in a series in which the first one has been struck a blow. At best the word can only be used to represent a convenient fiction, supposing this doctrine to express all there is of will in the human mind.

A short paragraph expresses incidentally the author's views as to the origin of the mechanism whose action expresses human motives and human intelligence. I quote it as being in consonance with views often expressed by the present writer, but opposed to those held by many of the physiological metaphysicians of the present day: "The will has for its basis a legacy coming down from generations innumerable, and registered in

[1] The Diseases of the Will. By Th. Ribot. Humboldt Library, No. 52. Translated by J. Fitzgerald, A. M.

the organism, namely, primordial automatic activity, which is almost invariable, and quite unconscious, *although in the distant past it must have been accompanied by a rudiment of consciousness* which later faded away, in proportion as coördination, growing more perfect, became organic in the species," p. 38. The italics are our own.—*E. D. C.*

SAGACITY OF THE HORSE.—On my farm, one Sunday, the house was left in charge of one man, who sat in the porch reading. A mare, with her young foal, was grazing in the orchard near by. At length he saw the mare coming from a distant part of the orchard at full speed, making a loud outcry—a sort of unnatural whinney, but, as he says, more like a scream of distress than the natural voice of the horse. She came as near to the man as the fence would allow, and then turned back for a few rods, and then returned, all the while keeping up the unnatural outcry. So soon as he started to follow her she ran back in the direction of a morass or miry place which had been left unguarded, and only stopped on its very brink. The man hastened to the spot with all speed, and found the colt mired in the soft mud and water. It was already dead.—*J. D. Caton.*

INDIVIDUAL IDIOSYNCRASY.—In an article contributed to *Mind*, entitled "Idiosyncrasy," Mr. Grant Allen contends that the psychical individuality or native character of each of us is nothing but a sum of innumerable inherited tendencies combined in a peculiar way. He argues against Mr. Darwin's supposition of accidental or spontaneous variations of brain structure, on the ground that the intricate structural relations involved in any appreciable improvement of cerebral functions could never be produced in this "accidental" way. *The Academy*, in noticing the article, then goes on to say: "It may, however, occur to the reader that the essayist is here soaring into the regions of purely hypothetical physiology. For aught anybody knows, a difference in the quality of the brain substance might entail important psychical consequences; and it is hard to see why 'spontaneous variation' should be able to modify 'indefinitely' such qualities of a plant or animal as 'hardness of skin' or 'woodiness of tissue,' and not be adequate to bring about changes in the tissues of the nervous substance which may have well-marked psychical accompaniments. However this may be, Mr. Allen has to confess that we know nothing of the causes which determine in any case the selection, from among the apparently infinite number of ancestral tendencies somehow present in a latent form in the parents' nervous organization, of that particular mixture of elements which constitutes the original idiosyncrasy. And, this being so, it would seem that we must still have resort to the factor of 'accident.'"

DOMESTICATION OF ANIMALS.—Galton, in his "Inquiries into Human Faculty," remarks that the few animals we now possess

in a state of domestication were first reclaimed from wildness in prehistoric times. Our remote barbarian ancestors, he says, must be credited with having accomplished a very remarkable feat, which no subsequent generation has rivaled. The utmost that weof modern times have succeeded in doing is to improve the races of those animals that we received from our forefathers in an already domesticated condition. Galton throws out the hypothesis that only a few species of animals are fitted by their nature to become domestic, and that these were discovered long ago by the exercise of no higher intelligence than is to be found among barbarous tribes of the present day. The failure of civilized man to add to the number of domesticated species would on this supposition be due to the fact that all the suitable material whence domestic animals could be derived has been long since worked out. His argument is this: "All savages maintain pet animals, many tribes have sacred ones, and kings of ancient states have imported captive animals on a vast scale, for purposes of show, from neighboring countries. I infer that every animal of any pretensions has been tamed over and over again, and has had numerous opportunities of becoming domesticated. But the cases are rare in which these opportunities have led to any result. No animal is fitted for domestication unless it fulfills certain stringent conditions which I will endeavor to state and to discuss. My conclusion is that all domesticable animals of any note have long ago fallen under the yoke of man. In short, that the animal creation has been pretty thoroughly, though half unconsciously, explored by the every-day habits of rude races and simple civilizations." He then cites numerous cases in support of this view. He says, however, on p. 261, that "a young bison will try to dash out its brains against the tree to which it is tied, in terror and hatred of its captors." *Per contra*, we saw, in 1877, a young buffalo, perhaps a yearling, walking freely and like an ordinary heifer about one of the stations on the Kansas Pacific Railroad, going leisurely across the track before an approaching train; and it is well known that the buffalo can be tamed and hybridized with the domestic cattle. At the same time the village Indians of our continent have never domesticated the buffalo; it is not to be expected that our nomad, hunter Indians would have domesticated any animals except the horse and dog, and the Indian pony may yet be proved to have been a descendant of the American Quaternary horse, and the Indian dog an offshoot from the coyote.

ANTHROPOLOGY.[1]

WEATHER PROVERBS.—What archæology is to modern art and myths are to the higher religions, folk-lore is to sound philosophy: It is the fossiliferous stratum of human thought. Every

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

department of human activity has its folk-lore, as every phase of human life has its antiquities. The chief signal officer of the U. S. Army has done a lasting favor to anthropology by including among the "Signal Service Notes" Lieutenant H. H. C. Dunwoody's collection of weather proverbs. The critics have been making merry over this book, and asking General Hazen whether the prophecies concerning the weather have been taken from the pages commencing with:

> "When the ass begins to bray,
> Be sure we shall have rain that day?"

Of course not, for these proverbs were the guide-book of the critics' own kindred down to the establishment of the Weather Bureau. In this octavo volume of 148 pages, the work of over 300 collectors, we have about all that is worth gathering of weather lore. In the letter of transmittal, Lieutenant Dunwoody points out that many weather prognostics "express in a crude form the meteorological conditions likely to follow, and they have resulted from close observation. The increase of aqueous vapor in the atmosphere is indicated by its effect upon animal and vegetable organization, and possibly in the future the accurate observation of such phenomena may serve to supplement the present instrumental methods." Part I of Lieutenant Dunwoody's work opens with a discussion on weather prognostics and their reliability, reprinted from the *Quart. Journ. of Meteorological Science.* Then follows the collection of proverbs, etc., arranged in alphabetical order under some important word. Part II gives a compilation of instrumental and other local indications of approaching storms.

Canonicus Memorial.—On the 21st September the Rhode Island Historical Society erected a monument to the memory of Canonicus. A short time since some workmen in excavating for a sewer in Providence, brought to the surface, from the depth of eight feet, a large boulder of granite, and this has been erected in the "glen" of the North Burial-ground, to commemorate the life and virtues of the great sachem.

Aboriginal American Authors.—At the Congrès International des Américanistes, Dr. D. G. Brinton read a paper which has been enlarged and printed, since his return, in the form of an octavo volume bearing the following title: "Aboriginal American authors and their productions; especially those in the native languages. A chapter in the history of literature. By Daniel G. Brinton, A.M., M.D." Philadelphia, pp. 63, 8vo. Everything about this volume is attractive, and this remark applies not only to the mechanical execution but to the matter. Most people will be startled when they are told that there is any such thing as a book written by an Indian. We have all heard of fervid oratory, a love of story telling, a fondness for tropes, and language with

grammatic structure; but were they employed in creating a literature? Both in English and Spanish creditable literary work has been done by Indians, there is no *a priori* reason, therefore, against their producing better books in their own language.

Dr. Brinton, commencing with the far north, calls to mind:

Rink's "Legends and Tales of the Eskimo."
Pok's (a Greenlander) Travels in Europe.
Kaladlit Assilialit, &c. (see Field's Indian Bibliog., p. 199).
Walum Olum (History of the Delawares). Beach's Miscellany.
The Iroquois Book of Rites. No. II. Lib. Aborig. Am. Lit.
Story of Francois Kaondinoketo. Paris, 1877.
National Legend of the Chahta-Muskokee tribes. Histor. Mag., Feb., 1870.
Sequoyah's Alphabet.

Passing southward into Mexico, Central America and S. America, Dr. Brinton has found much more that is valuable, but the list is too long to be repeated here.

MR. BANCROFT'S LIBRARY.—The historian, Hubert H. Bancroft, is in Mexico, with three assistants, gathering material for his "History of the Pacific States." He has been received by the leading literary men, as well as by the President of the Republic and heads of departments, with marked consideration and respect. His works have been carefully reviewed by Altamirano, Chavero, Riva Palacio and others, and the government has opened the archives anew to his secretaries, besides presenting him with copies of all its publications. The addition to his library, from his journey to Mexico, will not be less than 6000 volumes, mostly rare books and manuscripts, once lodged in churches and convents.

The second volume of the History of the Pacific States has appeared, being also Vol. II of Central America. Vol. IV, the first on Mexico, was published some time since. Vol. III will conclude the history of Central America and bring the work down almost to our day. Mr. Bancroft should be rewarded in his great labor by the most liberal patronage.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.—It really looks as though the Washington Anthropological Society would live to maturity. Vol. II of its Transactions has just appeared, including the journal and papers from Feb. 7, 1882, to May 15, 1883. An introductory statement gives a brief history of the society and the method of its proceedings. The list of officers, of members, honorary, corresponding and active, follows. The list of papers is given below:

Limits of the Innuit tribes of the Pacific coast. By Ivan Petroff. [No abstract.] p. 3.
The classification of objects in the new National Museum in its relation to anthropology. By Professor G. Brown Goode. [Synopsis] p. 5.
The treatment of aborigines by colonists of higher races. By Professor Otis T. Mason. [Abstract.] p. 8.

The gentile system of the Iowas. By Rev. J. Owen Dorsey. [Abstract.] p. 10.
Society as a domain of natural forces. By Lester F. Ward. [No abstract.] p. 11.
Life in Zuñi. By Frank H. Cushing. [Abstract.] p. 14.
The turning point of modern sociological science. By Dr. J. C. Welling. p. 15.
The Carson footprints. By Dr. W. J. Hoffman. p. 34.
Anthropology at the American Association. By Professor Otis T. Mason. [No abstract.] p. 38.
Soapstone quarries and aboriginal tools for working soapstone. By J. D. McGuire. [Abstract.] p. 39.
Mound explorations in Southern Illinois. By Professor Cyrus Thomas. [Abstract.] p. 39.
Tattooing among civilized people. By Dr. Robert Fletcher. p. 40.
On the Hawaiians. By Capt. C. E. Dutton. [No abstract,] p. 68.
An inquiry into the origin of invention. By Col. F. A. Seely. p. 70.
Aleutian songs and traditions. By Ivan Petroff. [Abstract.] p. 90.
The Carson footprints. By G. K Gilbert. [Abstract.] p. 91.
Art in shell. By William H. Holmes. p. 94.
Cannibalism. By Dr. J. Hamilton Porter. [Abstract.] p. 119.
Stone implements from Ghazipur, India. By H. Rivett Carnac. [A letter.] p. 122.
Dakotan legends and myths. By Rev. J. Owen Dorsey. [Abstract.] p. 124.
On Sir Rawson Rawson's deductions. By Dr. Robert Fletcher. [Abstract.] p. 125.
Comparison of Eskimo pictographs with those of other American aborigines. By Dr. W. J. Hoffman. p. 128.
Illustrations of mythology from Slav and Magyar folk-lore. By Mr. Jeremiah Curtin. [Abstract.] p. 147.
The Shetimasha Indians of St. Mary's parish, Southern Louisiana. By Albert S. Gatschet. p. 148.
Mound distribution in the United States. By Professor Cyrus Thomas. [Abstract.] p. 159.
The use of the cross symbol by the ancient Americans. By William H. Holmes. p. 161.
Origin of the sexes. By Dr. Charles E. Hagner. [No abstract.] p. 172.
Annual address of the president, Major J. W. Powell. Delivered November 6, 1883. p. 176.

THE AMERICAN ANTIQUARIAN.—This useful journal closes its fifth volume with the October number. The contents are:

Native races of Colombia, fifth paper. By E. G. Barney.
Mexican antiquities. By L. P. Gratacap.
The gentile system of the Omahas. By Rev. J. Owen Dorsey.
Primitive Northwest. By C. W. Butterfield.
Babylonian and Assyrian art. By W. St. C. Boscawen.

The editor contributes a timely paper on mound exploration and an illustrated article on medicine men and animal symbols. The linguistic and ethnographic notes in this journal, edited by A. S. Gatschet, are among its most valuable contents. The proof-reading, especially of German and French publications, ought to be improved.

THE PALÆOLITHIC MAN'S BEADS.—Mr. W. G. Smith, in *Nature*, Nov. 22, offers some statements confirmatory of the theory of

Dr. Rigollot, Sir Charles Lyell and Mr. James Wyatt, that the well known foraminiferous fossil, *Coscinospora globularis* D'Orb., was used by Palæolithic man in making necklaces and other ornaments.

POPULATION OF CHINA.—Minister Young, of Peking, writes to the State Department, under date of May 22, 1883, respecting the population of China, as follows: "I have been informed indirectly, but from official sources, that the census of China, as taken last year for the purpose of taxation, shows a total population of 255,000,000. This does not include the Mongolian or other outlying dependencies of the empire, but only the eighteen provinces of China proper. Nor does it embrace the aboriginal tribes which exist in very considerable numbers in the Island of Formosa and the provinces of Kuangsi, Yunnan, Knei Chow and Szchuan. Making due allowance for understatements due to the purpose for which the census was taken, and for the aboriginal tribes mentioned above, and for the Mongolian dependencies, which are really an integral part of the empire, it is probable that the sum total of the population of China really exceeds 300,000,000. (Consular Reports, Aug., 1883.)

NOTICES or reviews of the following anthropological works have come to hand:

Swedish Society of Anthropology and Geography. Extract from Minutes 1881 to 1883. *Matériaux*, XVII, 380–390.

Anthropological Society of Paris. Meetings of July 20, October 5, 19, November 2, 16, December 7, 21, 1882; January 4, 18, February 1, 15, March 1, 15, 1883. *Matériaux*, XVII, 290–400.

The fibulæ of the age of bronze and of the first age of iron. By Oscar Montelius. *Matériaux*, &c., XVII, 427–434.

On the methods of rock-sculpture. By Hans Hildebrand. *Matériaux*, &c., XVII, 434.

Annual report of the professor of anthropology to the Museum of Natural History, Paris, 1883. [M. de Quatrefages.]

Studies upon the ethnology of India. By Paolo Mantegazza. Part I. General problems. The Hindoos. *Archiv. per l'Anthrop e la Etnol.*, Florence, Vol. XIII, pp. 177–241.

Ligurians and Celts in the Valley of the Po. By Professor G. Sergi. *Archiv. per l'Anthrop. e la Etnol.*, Florence, XIII, pp. 117–176.

The doctor among the Red-skins of French Guiana. By M. Boussenarol. *Rev. Scient.*, 24 Nov., 1883, p. 656.

Studies upon dreams. By M. Alix. *Rev. Scient.*, 3 Nov., 1883, p. 554.

Leech, Dr. M. L., History of the Grand Traverse region, including prehistoric days, early Indian history, Jesuit possessions, etc., to be published in 1884, in the *Grand Traverse Herald.*

The Lake-dwellers of Venezuela. (*Phrenol. Jour.*) *Kansas City Rev.*, VII, 486.

Inselgruppen in Oceanien. By A. Bastian. Berlin, Dümmlers. 3 tables, pp. 282, 8vo.

Contributions to the anthropological literature of America. By Dr. Emil Schmidt. Brochure, pp. 411–435 from *Archiv. für Anthropologie.*

Human footprints in a quarry at Carson, Nev. By Marquis de Nadaillac. *Matériaux*, &c, XVII, 313–321.

A hut of the stone age discovered at Schussenried (Wurtemburg). By Dr. V. Gross. *Matériaux*, XVII, 321–323.

The horse in prehistoric and historic times. By C. A. Pietrement. *Matériaux*, XVII, 323–336.

MICROSCOPY AND HISTOLOGY.[1]

PURE CARMINIC ACID FOR COLORING MICROSCOPICAL PREPARATIONS.[2]—Since Gerlach first called attention to carmin as a coloring matter for histological purposes, many methods of preparing the carmin solutions have been published, but, so far as I am aware, none which result in anything but mixtures of various carmin salts with undetermined and undesirable impurities, such as fatty matter, tyrosin, sugar, and salts of alkaline metals. Of course the coloration produced by these mixtures has been sometimes good, sometimes bad, and the solutions have easily spoiled or decomposed, while their preparation often required considerable time and trouble. Several years ago I studied carmin, chiefly from a chemical standpoint, and since then I have often wondered why naturalists usually used carmin solutions in which water, with some caustic or destructive material added, was the principal solvent. Carmin of commerce, it is true, is not readily soluble, even in water, until ammonia, borax, or some other aid to solution is added; but carminic acid, the basis of the coloring matter of carmin, has long been stated in the leading chemical dictionaries and hand-books to be readily soluble in water and in alcohol. Watts (Dict. Chem., 1872, 1st suppl., p. 413) says of carminic acid: "This acid forms a purple mass, fusible and soluble in all proportions in water and in alcohol. Sulphuric and hydrochloric acid dissolve it without alteration. It bears a heat of 136° C. without decomposition."

Earlier still Watts (Dict. Chem., 1863, v. 1, p. 804) says: "The fine red pigment known in commerce as carmin is prepared by treating a solution of cochineal with cream of tartar, alum, or acid oxalate of potassium. The fatty and albuminous matters then coagulate and carry down the coloring matter with them." Now in preparing most carmin solutions this precipitation takes place, and the carmin, having greater cohesive (not chemical) affinity for impurities of animal origin than for alcohol, its solution is not readily accomplished by that medium, nor indeed by water. In preparing carmin solutions for histological purposes by some of the published recipes, more than one-half of the coloring matter of the carmin is lost in the refuse left upon the filter paper.

There are two ways commonly in use for preparing carminic acid, which term I here use as distinguished from "acid carmin" (the cochineal decoction for which Grenacher, Schweigger-Seidel,

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] By Geo. Dimmock. Read at the New York meeting of the Society of Naturalists of the Eastern United States, 28th Dec., 1883.

and others have given recipes) and from carmin (the impure commercial powder). The first mode of preparation, the one which I followed in preparing the acid upon which I have experimented is that of Warren De la Rue. Watts, whom I quote because he gives clear directions (Dict. Chem., 1863, vol. 1, p. 804), gives De la Rue's method, as follows: "To separate it [carminic acid] cochineal is exhausted with boiling water; the extract is precipitated by subacetate of lead slightly acidulated, care being taken not to add the lead-solution in excess; the precipitate is washed with distilled water till the wash-water no longer gives a precipitate with a solution of mercuric chloride, then decomposed by sulphuretted hydrogen; the filtrate is evaporated to a syrupy consistence and dried over the water-bath; and the dark purple product thus obtained is treated with alcohol which extracts the carminic acid." The second mode of preparing carminic acid, that of Schaller, is given by Watts (Dict. Chem., 1872, 1st suppl., p. 413) as follows: "C. Schaller prepares this acid by precipitating the aqueous extract of cochineal with neutral lead acetate slightly acidulated with acetic acid; decomposing the washed precipitate with sulphuric acid; again precipitating the filtrate with lead-acetate, and decomposing the precipitate with sulphuric acid, avoiding an excess; then precipitating a third time, and decomposing the precipitate with hydrogen sulphide. The filtered solution is evaporated to dryness; the residue dissolved in absolute alcohol; the crystalline nodules of carminic acid obtained on leaving this solution to evaporate are freed from a yellow substance by washing with cold water, which dissolves only the carminic acid; and the residue left on evaporating the aqueous solution is recrystallized from absolute alcohol or from ether."

Schaller's mode of preparation gives purer carminic acid than De la Rue's, but either kind is sufficiently pure for histological purposes. The precipitation by lead acetate and the dissolving in alcohol free the carminic acid from animal impurities, and the consequence is a purer form of pigment than can be extracted by any process hitherto employed for the preparation of carmin for histological purposes. I will here add that carminic acid has been shown recently by Liebermann and Van Dorp to be related, through nitrococcusic acid, to trinitrocresol, which has been obtained from coal-tar cresol, thus showing that the coloring matter of cochineal contains methylated benzine-residues.

I do not know whether carminic acid, ready prepared, is obtainable. Any chemical student could easily prepare it by the processes given above.

It is unnecessary to explain to naturalists the advantages of alcoholic solutions of carmin over aqueous ones. The alcoholic solution colors preparations much quicker than the aqueous solution does; for coloring sections I employ a solution of 0.25 gram carminic acid to 100 grams of eighty per cent alcohol, and leave

sections in the solution from two to five minutes. A solution of equal carmin strength but in absolute alcohol can be employed; it has, however, no special advantages, since with the eighty per cent alcoholic solution the sections can be washed directly in absolute alcohol, and then put into oil of cloves or turpentin. Coloring in the piece before sectioning never takes as long with alcoholic carminic acid as it does with ordinary carmin solutions, and if it did take long the strong alcohol would preserve the tissue from maceration. In coloring pieces of mollusca, or of other equally slimy animals, the slime should be removed beforehand, or the coloration will be unsatisfactory, because the slime congealing in the alcohol takes up the coloring matter, forming an almost impervious colored layer on the outside and leaving the inside of the piece nearly uncolored.

Some preparations colored in alcoholic carminic acid and then put up in glycerin lost their color in a few months, the color seeming to be entirely diffused in the glycerin, while similar preparations mounted in Canada balsam retained their color perfectly. I do not know if this fading would occur with preparations colored with alcoholic ammonic carminate, or even if this diffusion was not due to some impurity of the glycerin (of the purity of which I was doubtful); time to test this matter further failed.

An alcoholic ammonic carminate, or ammonia carmin, can be prepared, at a moment's notice, from alcoholic carminic acid, by adding ammonia, drop by drop, and stirring until the entire solution changes from its bright red to purple red. By this mode pure alcoholic ammonic carminate can be produced with no excess of ammonia, and at any time. As the carminic acid can be preserved dry without decomposition, and dissolves quickly in alcohol, one can carry the ingredients of a carmine solution in the vest pocket, without inconvenience.

In making and using alcoholic carminic acid pure alcohol and distilled water give the best results, because a portion of the carminic acid is converted to carminates by the salts of impure water. In making alcoholic ammonic carminate this precaution is not as necessary, because the color of the carminates produced by the impurities of the water is so nearly like that of ammonic carminate.

Alcoholic carminic acid may be used, as Grenacher's carmin solution is used, to color sections from which the coloration is to be afterwards partly extracted by very dilute hydrochloric acid, leaving nuclei red. Another way to use carmin solutions, which is especially applicable to alcoholic carminic acid, is to precipitate the carmin in the tissues by some salt, the carminate of the base of which gives a desired coloration. I have found, for example, that specimens hardened for a moment under the coverglass with an alcoholic solution of corrosive sublimate (mercuric chloride) and, after washing with alcohol, colored in alcoholic

carminic acid, took a fine coloration of mercuric carminate. So, too, specimens colored in alcoholic carminic acid can be changed by a few moments' treatment with a *very dilute* alcoholic solution of lead-acetate or cobalt nitrate to a beautiful purple. With lead acetate used as above a double coloration is sometimes produced, but I have not examined sufficiently these colorations to accurately describe them. Cupric and other salts, used as above described, have not given me very favorable results. Sometimes salts in the tissues of the animals themselves change portions of the carminic acid to purple carminates, giving a double coloration without further treatment.

Picric acid added to alcoholic carminic acid *in extremely small quantities* (best in a dilute alcoholic solution, testing the solution on specimens after each addition) makes a double alcoholic coloring fluid (a so-called picro-carmin). I have been unable thus far to determine the proportion of picric acid required for this solution, having in every case added an excess. All different kinds of carmin solutions can be made from carminic acid with the advantage of having always uniform strength, of being definite mixtures, and of not spoiling as readily as those made directly from cochineal.

Incompatible reagents with carminic acid are, of course, all alkaline solutions and nearly all metallic salts; with ammonic carminate, are naturally all acids; with all carmine solutions, are bromine and chlorine.

I hope later to try some coloring experiments with coccinin, ruficoccin, carmin red, and ruficarmin, all of which are derived from carminic acid, and of possible value to the histologist.

Structure of Secretory Cells and their Changes in Secretion.—The histological structures of the various secretory cells have been described by different observers, as well as the changes undergone in them during the act of secretion. But these descriptions exhibit many discrepancies, which are largely due to the differences between the methods employed in studying the tissues. Mr. J. N. Langley, whose experience eminently qualifies him for such a task, undertakes to combine all that is true in our conceptions of the secretory cell. He says: "The glands of vertebrates in which I find that the secretory cells have fundamentally the same structure are—the serous and mucous salivary glands, and the similar glands of the mucous membrane of the mouth, nose, larynx, œsophagus, etc.; with a few exceptions, the 'chief' cells of mammalian gastric glands; the gastric glands of such birds, fishes, reptiles and amphibia as I have examined; the œsophageal glands of the frog; the pancreas; the liver. * * * * The secretory cells of all the glands in the list which I have given have the following common points of structure: The cell substance is composed of *(a)* a framework of living substance or protoplasm, connected at the

periphery with a thin continuous layer of modified protoplasm; the framework in some cases has the form of a network of small threads of equal size as described by Klein, in others of flattened bands. Further, the threads or bands may vary in size in different parts of the cell, and the meshes in different parts of the cell may be of different size and shape. Within the meshes of the framework are enclosed two chemical substances at least, viz., *(b)* a hyaline substance in contact with the framework, and of *(c)* spherical granules which are embedded in the hyaline substance. In the gland cells which secrete much organic matter the cell granules are conspicuous and fairly large. In the gland cells which secrete comparatively little organic matter the cell-granules are, generally speaking, smaller and less distinct, the lower the mean percentage of organic matter is in the fluid secreted. The cell-granules are in nearly all cases mesostales, *i. e.*, substances stored up in the cell and destined to give rise to the organic substances of the secretion. The granularity of a cell in the resting state thus depends upon its storage power. Generally speaking, the greater the storage power of a cell, the higher is the percentage of the organic substance in its secretions, but this is not always the case, since it may happen that the rate of secretion of water may increase without any corresponding increase in the rate of secretion of organic substance, and in consequence the percentage of organic substance in the secretion may be small; further, it is possible that under special circumstances a cell with small storage power might secrete a large quantity of its stored-up material, and that a cell with a large storage power might secrete a very small quantity of its stored-up material, the amount of water secreted by the two cells being approximately equal. In all these cells, during active secretion, the following changes take place: The granules decrease in number, and usually, if not always, in size; the hyaline substance increases in amount; the network grows. The increase of the network is much less than that of the hyaline substance. Moreover, in the majority of cells the details of the changes which take place are much the same. The hyaline substance increases chiefly in the outer region of the cells, and the granules disappear from this region, so that an outer non-granular zone and an inner granular zone are formed. The network stretches throughout the cell in all cases. In the outer zone its meshes are filled with hyaline substance; in the inner zone its meshes are filled with granules and a small amount of hyaline substance. The glands in which an outer non-granular zone is not formed during secretion are most of the gastric glands of the frog and toad, the gastric glands of the snake, and the liver of mammals. * * * * It is to be remembered that there is reason to believe that the three parts of the cell are continually being formed and changed into other substances. * * * The differences

shown by the different cells after the same treatment depends partly upon the different chemical characters of the framework, hyaline substance, and granules in the different cells, and partly upon the different arrangement of these constituents. * * * An obvious hypothesis is that the protoplasmic network forms the hyaline substance, and then out of this manufactures the granules, which are, as we know, converted during secretion into some one or more of the organic bodies of the fluid secreted. * * * The network appears to be the result of the two-fold tendency of the protoplasm to form fibrillæ, and to store up substances within its grasp; in most cases it is obviously not constant in form, but is continually altering the arrangement of its bars and the size of its meshes. This is especially distinct in mucous cells in which, during secretion, numerous fresh connecting fibrillæ are formed."—*Proc. Camb. Philos. Soc., Vol. v.*

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS.—This volume of 275 pages contains the proceedings of the sixth meeting of this active society, which was held at Chicago, Aug. 7–10, 1883. It has been edited by Dr. D. S. Kellicott, and has certainly been issued with promptness. The address of President McCalla was on the verification of microscopic observation. The specially microscopical articles were the following: College microscopical societies, by Sarah F. Whiting; the relation of aperture to amplification in the selection of a series of objectives, by Geo. E. Blackham; division of labor among microscopists, by J. M. Mansfield; photo-micrography with dry plates and lamp light, by W. H. Walmsley; the preparation and mounting of Foraminifera, with description of a new slide for opaque objects, by F. M. Hamlin; preparing and mounting bacteria, by T. J. Burrill; the microscope in the detection of lard adulterations, by W. T. Belfield; a new method of dry mounting, by A. H. Chester; a new form of microscope stand with concentric movements, by J. D. Cox; a critical study of the action of a diamond in ruling lines upon glass, by W. A. Rogers; cataloguing, labeling, and storing microscopical preparations, by S. H. Gage. There are also reports of the committee on eye-pieces, micrometry, centimeter scale A, 1882, a study of centimeter, marked A, prepared by the U. S. Bureau of Weights and Measures, by W. A. Rogers, and rules for the control of the standard micrometer.

"THE MICROSCOPICAL BULLETIN."—The first number of the new *Microscopical Bulletin*, to be published bi-monthly by James W. Queen & Co., Philadelphia, appeared in December. This publication is designed to answer the question, "What's new in the microscopical line?" The first number consists of eight double-column octavo pages, and contains the more interesting portions of Professor Duncan's address before the Roy. Mic. Soc., in 1882; a short essay on pathogenic bacteria, a description of a new slide-box, and other microscopic accessories.

SCIENTIFIC NEWS.

— It is proposed to collect the means to honor the memory of the late excellent naturalist and scholar, Dr. Hermann Müller, of Lippstadt, Germany, by supporting the widow of the deceased, by creating a memorial, and by establishing a foundation, which shall bear the name of *Müller Foundation.* After the death of Professor Müller's widow, it is proposed that the interest of the memorial sum shall be given preferentially to some descendant of Professor Müller who shall devote himself to the study of natural philosophy, or else to some other needy and worthy student of that science who shall have been educated at the Public School of Lippstadt. The realization of these wishes will depend on the amount of funds to be collected, which shall be employed according to the final decision of a committee composed of the provisional one at Lippstadt and twice its number of donors from abroad. The committee purposes to send a biography with portrait of the late Müller to all those who have signified a real interest in the aforesaid foundation.

The editors of the AMERICAN NATURALIST very heartily endorse this appeal, and will take charge of and forward to the treasurer of the German committee any subscriptions they may receive from the American friends and correspondents of Hermann Müller.

— Professor Richard Owen, who is now eighty years old, has resigned the superintendency of the Natural History Collections of the British Museum at South Kensington. As a tribute to his genius and indefatigable scholarship, he has been made a K. C. B. Sir Richard Owen is still activein palæontological and morphological studies. Some idea of his industry may be gathered from the fact that he published, between 1830 and 1873, no fewer than 368 papers, the titles of which are given in the Royal Society's list, and since then he has contributed several others to the Transactions of the Royal and the Geological, Linnæan, and Zoölogical Societies, besides his Comparative Anatomy of Vertebrates, his Odontology, his Fossil Reptiles, and other works.

— The Bulletin of the Nuttall Ornithological Club is replaced by "*The Auk*, a Quarterly Journal of Ornithology." Why the two first words should be prefixed to what is otherwise a suitable title we are at a loss to understand. Of the hundreds of English names of birds, the one selected seems to our unaided mental vision to be the most unfortunate. A bi-syllabic title of some respectable bird still in the land of the living would evince better editorial taste. We question whether the bird's name did not have something to do with the extinction of the great auk. Barring its awkward, gawky cognomen, *The Auk* comes to us, however, as fat and juicy as ever was its prototype—and long may it "wobble"!

— M. Pasteur has shown that the bacillus of "rouget," as found in pigs, can be attenuated by passing it through rabbits. The inoculated rabbits are all rendered very ill or die, but pigs inoculated with the bacillus, after the virus has been passed through a series of rabbits, have "rouget" in a mild form, and enjoy immunity from further attacks. A series of inoculations carried through pigeons, on the other hand, increases the virulence of the disease when a pig is inoculated from the last of the pigeons.

— A change has recently been made in the constitution of the Royal Academy of the Lincei, in Rome, by which foreign members of all grades are admitted to an equal dignity with the regular members, and be participants in the same rights, and this was confirmed by the decree of King Humbert the First, on the 26th of July, 1883.—*F. V. H.*

— Mr. J. Starkie Gardner, of London, is preparing to bring with him, next summer, to this country a number of series of Eocene fossils of England. Each series will consist of twenty-five specimens, and each specimen will be seventy or eighty inches in superficial area, cleaned and hardened and in a separate case. Price £15.

— M. Cartailhac has communicated to the French Academy of Sciences a description of some old flint mines in Miocene strata, near Mur-de-Barrez, Aveyron, which appear to have been worked by Neolithic miners. This is stated to be the first discovery of prehistoric mines in France.—*English Mechanic.*

— We received, December 20, 1883, a general geological map of the area explored and mapped by Dr. F. V. Hayden and the surveys under his charge from 1869 to 1880. One can obtain a clear idea of the relations of the formations of an area of over 500,000 square miles in extent.

— Of the fourteen circumpolar expeditions eleven have safely returned. The Russian at the mouth of the Lena, and the Finnish at Sodankyla, will be continued for another winter, while the fate of the American expedition to Lady Franklin bay is unknown.

— We regret to notice the stoppage of Dr. C. F. Lutken's popular Danish Journal of Science, the *Naturhistorisk Tidsskrift*, which has been successfully conducted and well patronized in Denmark for nearly twenty years.

— The excellent German scientific monthly, *Cosmos*, begins January, 1884, in a new form and cover. It proposes more especially than heretofore to be an exponent of the doctrines of development.

— Mr. Romyn Hitchcock announces that the American Monthly Microscopical Journal, for 1884, will be published hereafter by himself, at Washington, D. C. (P. O. box 630.)

—Professor Flower is spoken of as the successor of Professor Owen as director of the South Kensington Museum, London.

— Fossil fishes of the Green River shales may be had from S. H. Sommers, St. Joseph, Mo.

— Brig.-Gen. Andrew A. Humphreys, U. S. A., retired, died suddenly at Washington, D. C., Dec. 28, from an attack of *angina pectoris*. The deceased had a brilliant record, both military and civil. At the close of the war he was assigned to duty as chief of engineers, which office he filled until June 30, 1879, when he was retired at his request. He was a member of various American and foreign societies. He will be remembered for his work in connection with Gen. Abbot in the physics and hydrography of the Mississippi river. He was also chief of the surveys for the Pacific railroad, finishing his report in 1861.

— The death is announced of Professor Sven Nilson, the well-known Swedish naturalist, at the ripe age of ninety-seven. He was born at Landskrona, in March, 1787, and so long ago as 1811 obtained the degree of Ph. D. from the University of Lund. His magnum opus is the work on the Scandinavian fauna which occupied him for more than thirty-three years. His last important work was The Primitive Inhabitants of Scandinavia.

— Professor Wm. Denton, of Wellesley, Mass., recently died of fever in New Guinea. His two sons, who were with him, have recently returned to this country, bringing with them a large collection of birds. They state that the natives they met with are friendly.

—As we go to press we hear of the death of Professor Arnold Guyot of Princeton, the well known geographer and geologist.

— The death is also announced of Professor Ercolani, of Bologna.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN PHILOSOPHICAL SOCIETY, April 20, 1883.—Mr. E. W. Claypole read a paper by Professor H. S. Williams, entitled "On a Crinoid with movable spines." The same gentleman also read a paper making a correction of the geological map of Perry county, south of New Bloomfield. At this spot the Lower Devonian is faulted down 3500 feet against the Upper Helderberg.

May 18.—Mr. E. W. Claypole communicated a note "On a relic of the native flora of Pennsylvania, surviving in Perry

county," with specimens of *Vaccinium brachycerum* Mich. (*Gaylussaccia brachycera* Gray).

June 16.—Professor Cope presented the following papers from Dr. A. S. Packard: On the morphology of the Myriopoda; A revision of the Lysiopetalidæ, a family of Chilognath Myriopoda, with a notice of the genus Cambala. Mr. Grote communicated a paper upon the Noctuidæ. Twenty-four sub-family groups are here proposed and the structure discussed. About half-a-dozen forms of this family were known in 1859, between which date and 1883 Mr. Grote himself described about 100 genera and 1000 species, so that the total number of species known is now about 1700. The outlines of Mr. Grote's theory of geographical distribution and migration are also given in this paper.

Aug. 17.—A paper upon a large crustacean from the Catskill group of Pennsylvania, by Mr. E. W. Claypole, with a note "On the genus Renssalaeria in the Hamilton group of Perry county, Pennsylvania," and another upon "The equivalent of the New York Portage group in Perry county, Pennsylvania," both by the same author, were read. Specimens of rye, barley, and wheat grains that had sprouted in ice were exhibited, with a letter from Mr. J. Lesley.

Oct. 5.—The Secretary read an article of Professor D. Kirkwood upon the "Zone of Asteroids and the rings of Saturn."

Oct 19.—An annotated translation of the Ramirez MS., giving the history of the Mexicans from their paintings, was communicated by Mr. H. Phillips, Jr. A memoir by Dr. J. C. Branner, upon the course and growth of the fibro-vascular bundles in palms, was also read. Dr. Frazer exhibited a map of Radnor township and the surrounding district, showing the belt of syenite gneiss which runs east and west from Radnor to Wayne stations. Dr. Frazer also discussed the stratigraphical relationships of the serpentine belt south of it. He considered the magnesian beds as original parts of the series, instead of exogenous, as maintained by Mr. Rand.

Nov. 16.—Professor Cope described the formations of New Mexico, the fossils of which he had been studying in his recent journey.

Dec. 7.—Mr. Lilly's section of 1855 feet of Devonian rocks, visible in Gulf Brook gorge, at Leroy, Pennsylvania, was presented. Professor Houston described Mr. P. B. Delancey's method of obtaining perfect self-adjustable synchronism in his synchronous-multiplex telegraph. Professor Cope communicated papers entitled: "On the distribution of the Loup Fork formation in New Mexico;" "Second addition to the knowledge of the Fauna of the Puerco epoch;" and "On the trituberculate form of molar tooth in the Mammalia."

Dec. 21.—Professor Rothrock read a paper entitled "The microscopical examination of timber with regard to its strength,"

by F. M. Day. Dr. H. Allen read a paper "On a case of human congenital malformation," and exhibited photographs.

Jan. 4, 1884.—Professor Lesley presented a note upon the possible original meanings of the animal ideographs of the god Set.

PROCEEDINGS OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Nov. 8.—Dr. Sharp called attention to the presence of retinal cells upon the siphon of Solenensis. His attention was first drawn to the matter by observing that these mollusks retracted the siphon when the shadow of his hand passed over the water of the dish they were contained in. Mr. T. Meehan gave an account of his visit to Alaska. The Davidson glacier is retreating, but the great Muir glacier, which has a frontage of two miles, a thickness of 960 feet, and is said to be 400 miles long, still pours its icebergs into the ocean. The region is singularly favorable to vegetation, and the forests, though of few species, are often so dense as to make travel impossible. The trunks frequently touch, in which case their timber is of little value.

Nov. 15.—Dr. Randolph called attention to the structure of the wheat grain. His methods had rendered apparent the presence of gluten in the body of the cell, while the so-called gluten cells of the cortex do not respond to any artificial digestion, and seem to have but little nutritive value.

Professor Heilprin said that a small collection of fossils sent by Professor Cope from Laredo, Texas, proved that the Claiborne or Parisian formation extended south to that point. There is little doubt that it penetrates some distance into Mexico. There must, at some point near this locality, be a contact with the brackish water or terrestrial strata, of as yet undetermined age, to be found further inland.

Nov. 21.—Dr. Sharp called attention to Professor Semper's method of preparing dried specimens of soft animals, and exhibited some beautiful examples.

Dr. Leidy described an older method in which hot tallow was injected, aud afterwards dissolved out with turpentine. Professor Cope spoke of the cretaceous formations, Nos. 4, 5 and 6, in the central part of Dakota, and of extensive buttes lying on the plain. These buttes contained fossils characteristic of the White River Miocene beds.

Dr. Hayden said that the fresh-water lake indicated by these deposits must have extended over 100,000 to 150,000 sq. miles.

Rev. Dr. McCook stated that the occident ant (*Pogonomyrmex occidentalis*) was in Dakota confined to the bottom lands along the Missouri river; it does not stretch eastward of that river in the state of that name, and is absent in Eastern Nebraska, though it abounds in the west of that State, and in Kansas does not occur further east than Brookville. The dèbris collected from the nests

contained some undeveloped pods of *Dalea alopecuroides*, the refuse of the harvesting of these creatures.

A paper entitled "Notes on American Fishes Preserved in the Museums of Berlin, London, Paris and Copenhagen," by D. S. Jordan, was presented for publication, as also one on "Staining with Hæmatoxylon," by Dr. C. L. Mitchell.

Nov. 29.—Rev. Dr. McCook exhibited and described the tent and egg-nest of *Attus opifex*, a Californian saltigrade spider. Dr. McCook also reported the discovery on the Wissahickon of *Psocus expunctatus*, a web-spinning neuropterous insect, not before known to occur in this country. Dr. Horn exhibited specimens of the curious beetle *Platypsylla castoris*, parasitic upon the beaver. These specimens came from European beavers living at the mouth of the Rhone, but the species was first described from examples taken from an American beaver living at Amsterdam. Mr. Cresson described some Aztec bells, considered the probable mode of their manufacture, and compared them with Peruvian, Assyrian and Egyptian forms.

Dec. 6.—Professor Lewis exhibited some gold nuggets from Montgomery county, N. C. Professor Cope placed on record a new genus of mammals supposed to be Lemuroid from the Puerco Eocene. The typical species is *Indrodon malare.*

December 12.—Rev. Dr. McCook described the manner in which the queen ant starts a formicary, as illustrated by the wingless queens of *Camponotus pennsylvanicus.* These had walled themselves in with small particles of bark. Professor Heilprin gave the results of his studies upon the tertiary and cretaceous of the Atlantic and Southern States. The three lowest Cretaceous deposits belong to the Senonian, and the upper one to the Mæstricht group. The boundary of the tertiary was traced through Virginia and the Carolinas. Patches of eocene occur along the rivers of North and South Carolina. Professor Cope exhibited the skull of *Aphelops fossiger* from the Loup Fork strata of Sand creek, an affluent of the San Francisco river, New Mexico. Photographs of an Aphelops indistinguishable from this species indicated the existence of the Loup Fork beds near the City of Mexico. Mr. Wortman referred to similar remains in Florida, indicating the presence of the same beds. Professor Lewis announced that the angles of a mineral described by him at a previous meeting as new, were identical with those of Sarcolite. The large size of the crystals found in Canada is remarkable. Dr. Leidy stated that he had learned that the supposed fresh-water cephalobranch worm Manayunkia, recently described by him, was found in a mill-pond some times overflowed by the ocean, so that, after all, the species may be marine. Dr. A. J. Parker called attention to what may prove a new method of reproduction observed by him in *Amphileptis fasciola.* The lengthened extremity of one of these infusorians broke up into little masses of protoplasm having

amœboid movements, although the cilia of the creature continued active. A bud then appeared in the ectosarc, which was followed by the endosarc, and grew until the original form was attained. Rev. Dr. McCook spoke of the architecture of *Formica rufa*, as displayed in Dakota. This ant is European, but occurs also on the plains, even to the elevation of Leadville. It is not found on the Atlantic sea-board.

BIOLOGICAL SOCIETY OF WASHINGTON.—The fourth anniversary meeting was held on Friday evening, January 25th. The President, Professor Charles A. White, delivered the annual address upon: "Certain phases in the geological history of the North American continent, biologically considered."

NEW YORK ACADEMY OF SCIENCES, Jan. 7.—The paper of the evening was: Notes and criticisms on Mr. Grant Allen's theory of the origin of leaf-forms (illustrated with specimens), by Dr. N. L. Britton.

Jan 14.—The following papers were read: The erosive power of glacier ice, and its influence on the topography of North America, by Dr. John S. Newberry; "Field-work in local mineralogy, by Mr. B. B. Chamberlin.

Jan. 21.—The following paper was read: Methods of animal self-defence (illustrated with lantern), by Professor H. L. Fairchild.

Jan. 28.—Professor J. W. Powell, of Washington, D. C., delivered a lecture on: The mythology of the Indians of the Sacramento valley.

AMERICAN GEOGRAPHICAL SOCIETY, Jan. 24.—The lecture of the evening was on the exploration of Petra-Arabia, by Edward L. Wilson, Ph.D., illustrated with views.

BOSTON SOCIETY OF NATURAL HISTORY, Jan. 16.—Mr. S. Garman spoke on the "sea-serpent," and showed a remarkable new Selachian. Mr. W. O. Crosby discussed the relation of the slates and conglomerates of the Boston basin.

APPALACHIAN MOUNTAIN CLUB, Jan. 9.—Annual meeting. The reports of the Secretaries and the Treasurer were presented, and the annual election of officers held. Mr. Elizur Wright read a paper on "The sanitary effect of forests." Rev. William C. Winslow read a paper on "Mount Zion, to-day."

Jan. 18.—Special meeting. Mr. Fred. A. Ober read a paper on "Mexico," including an ascent of Popocatapetl; a large number of lantern views being shown.

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND, Jan. 12.—One new member was elected and other business transacted. Mr. C. W. Leng then read a paper on the Cicindelidæ of Staten Island. Remarks were made by Mr. Sechusen on a very interesting series of precious stones, their particular characters, and the localities from which they came. He presented the collection to the society.